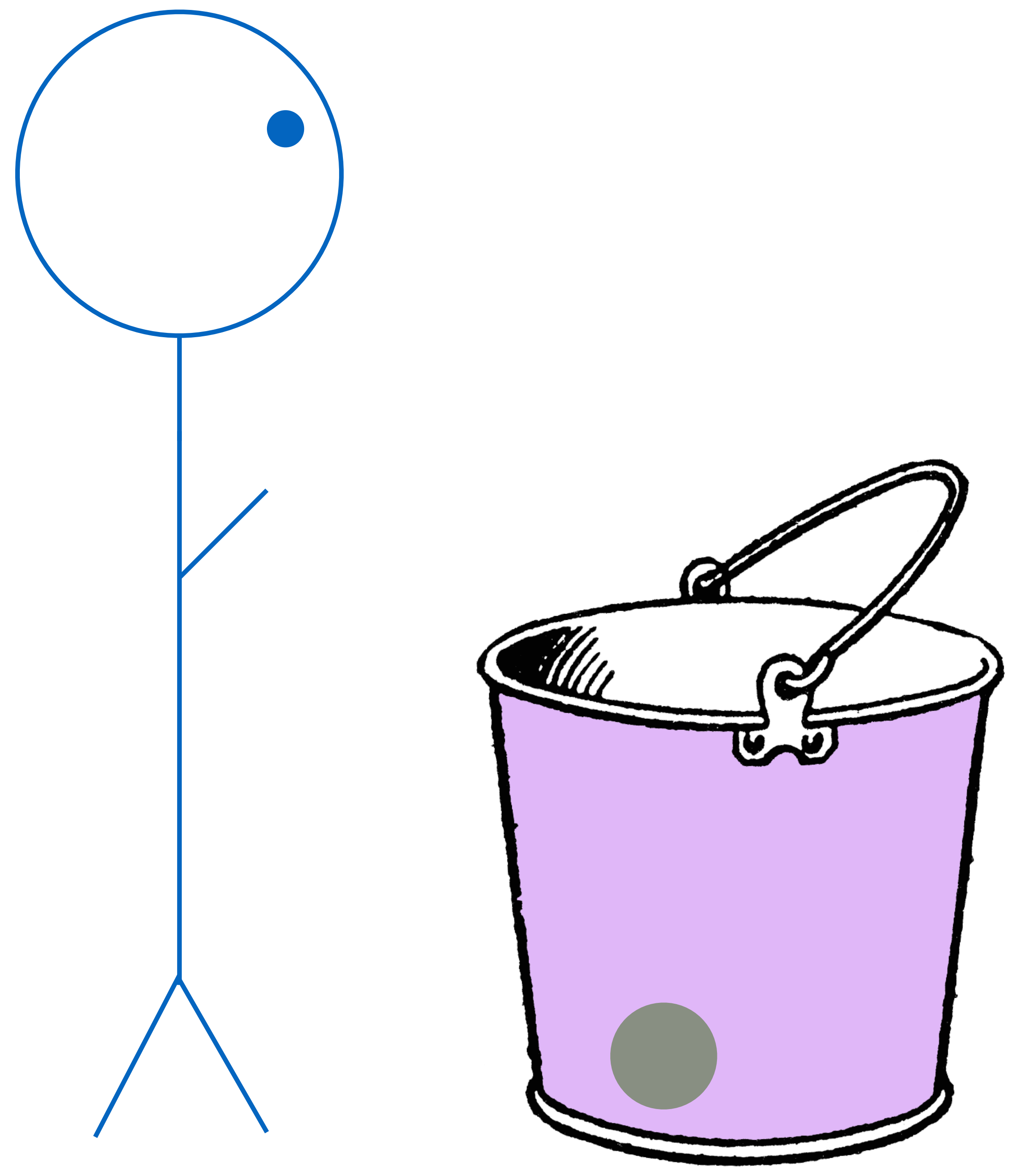
Semaphores

Ryan Eberhardt
July 26, 2021

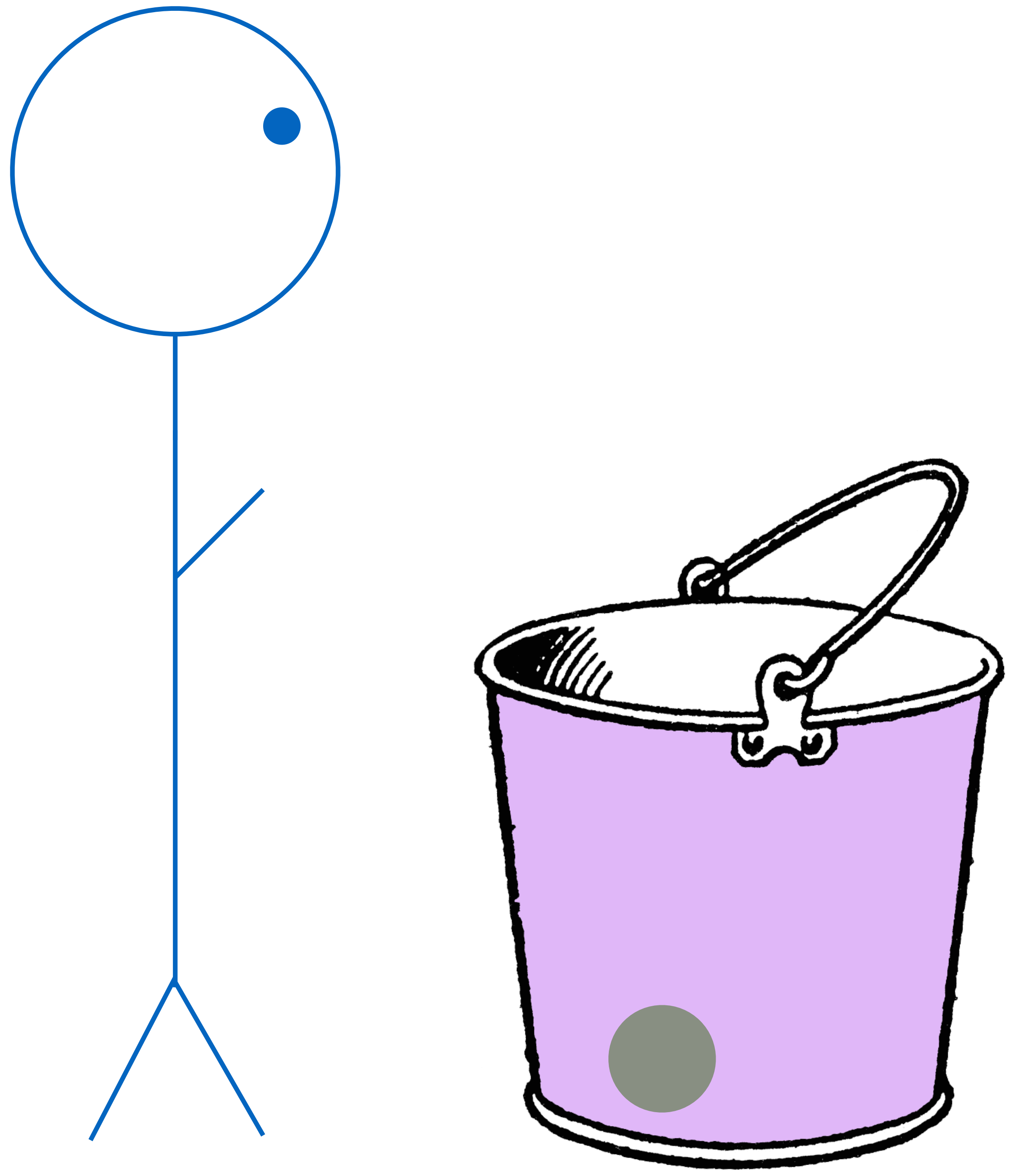
Semaphores


thread1

Semaphores

semaphore.wait()

If necessary, waits for a ball to be added to the bucket; then, takes the ball



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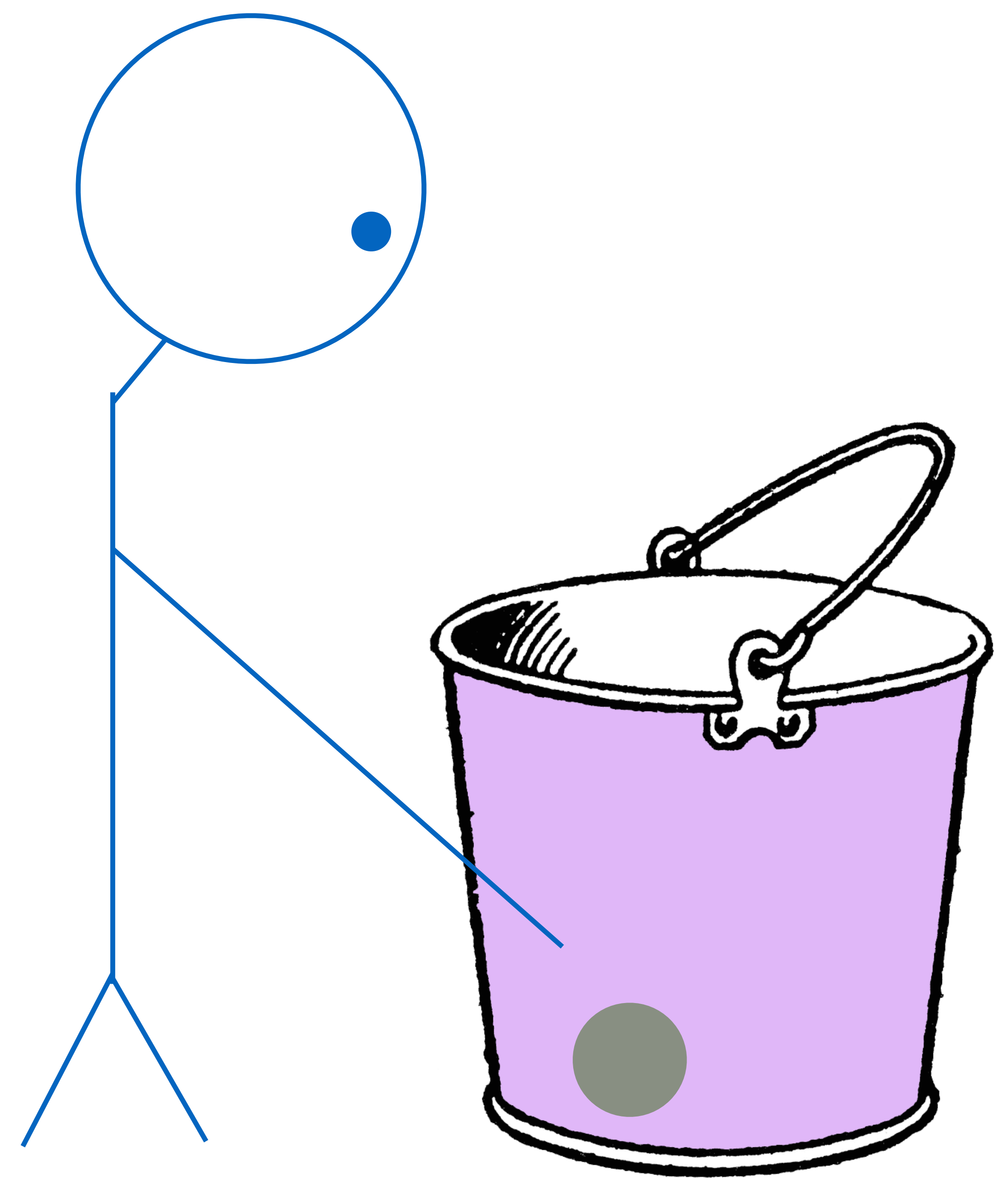

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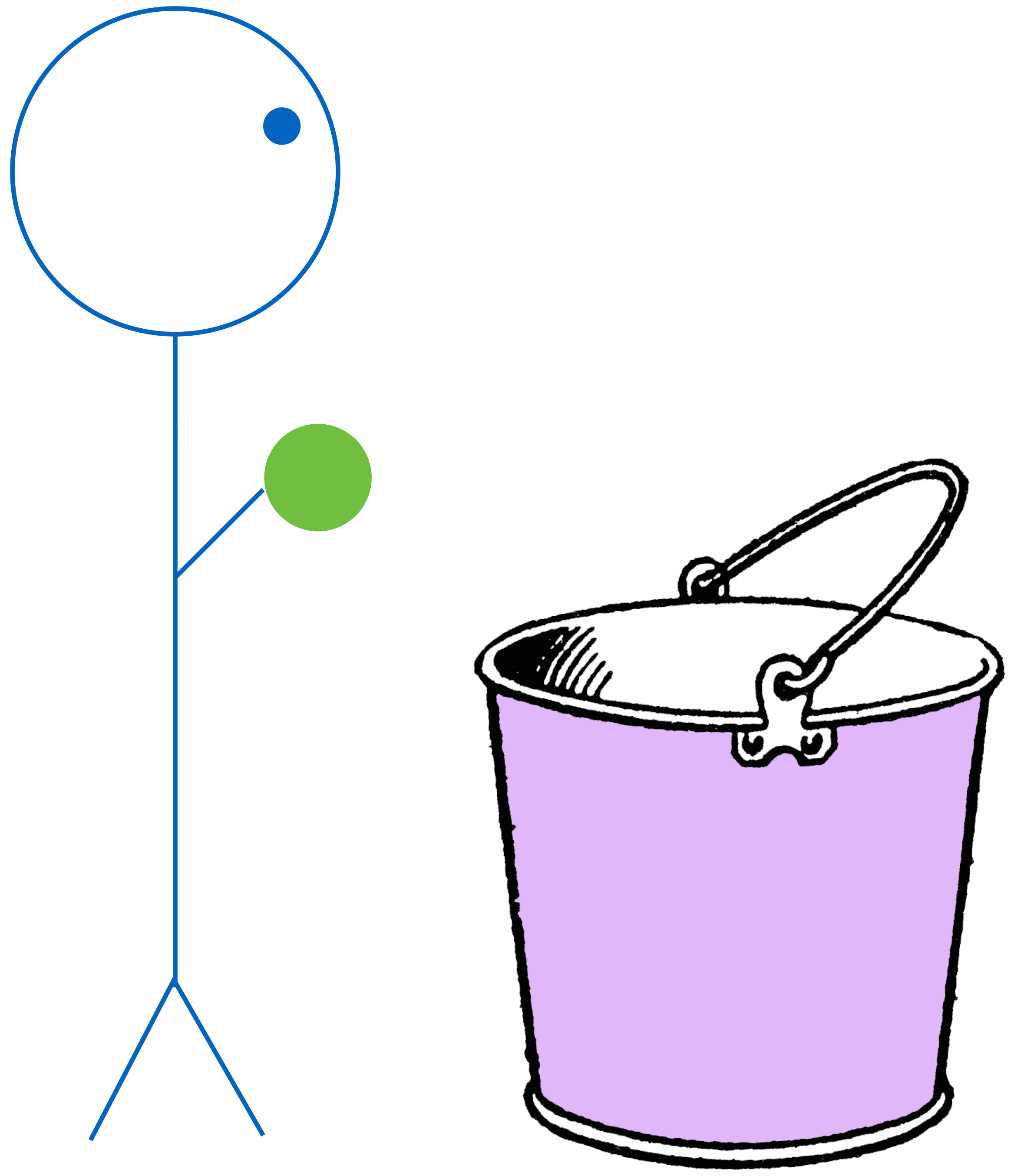

thread1

Semaphores

semaphore.wait() (again)

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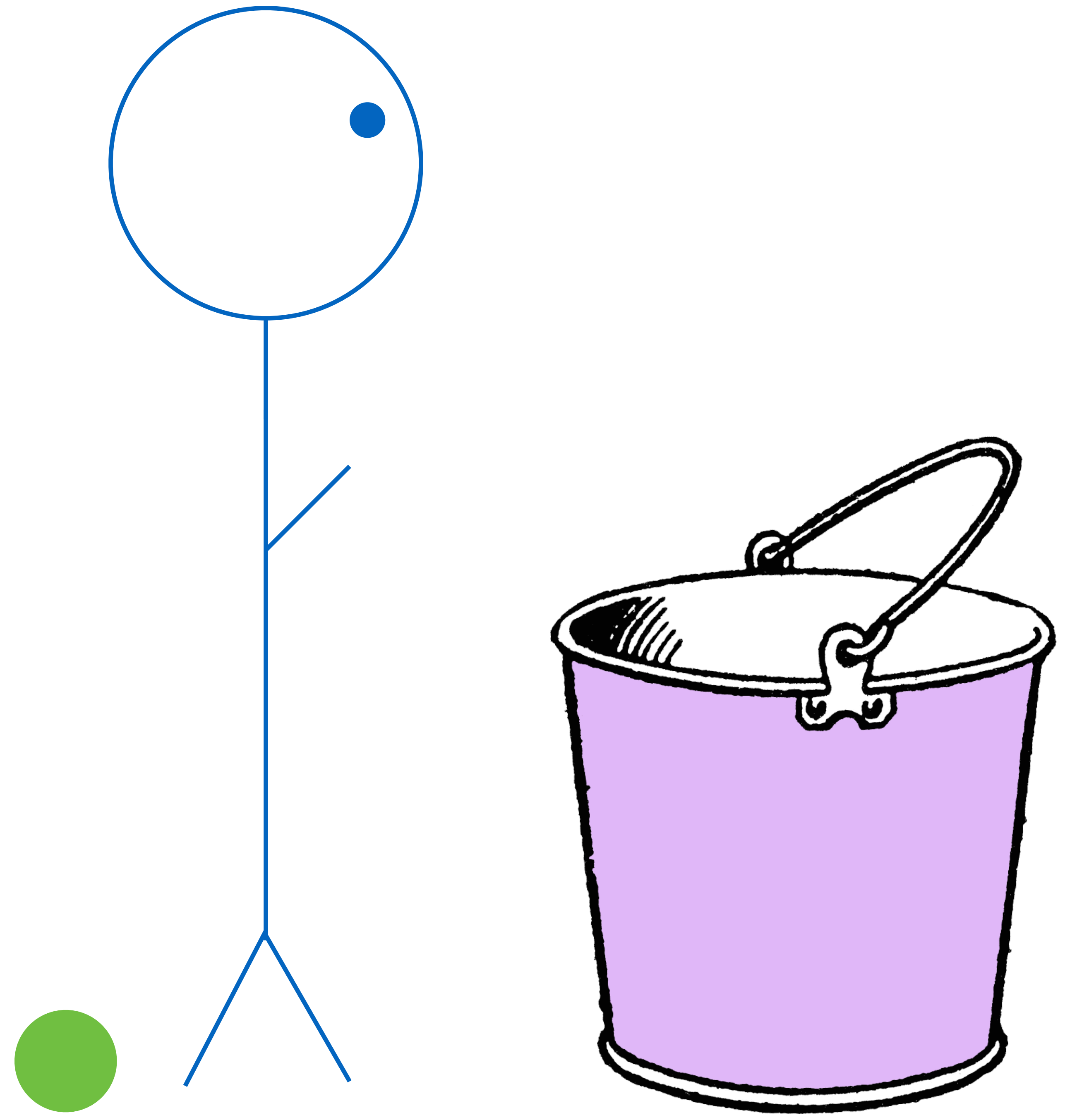

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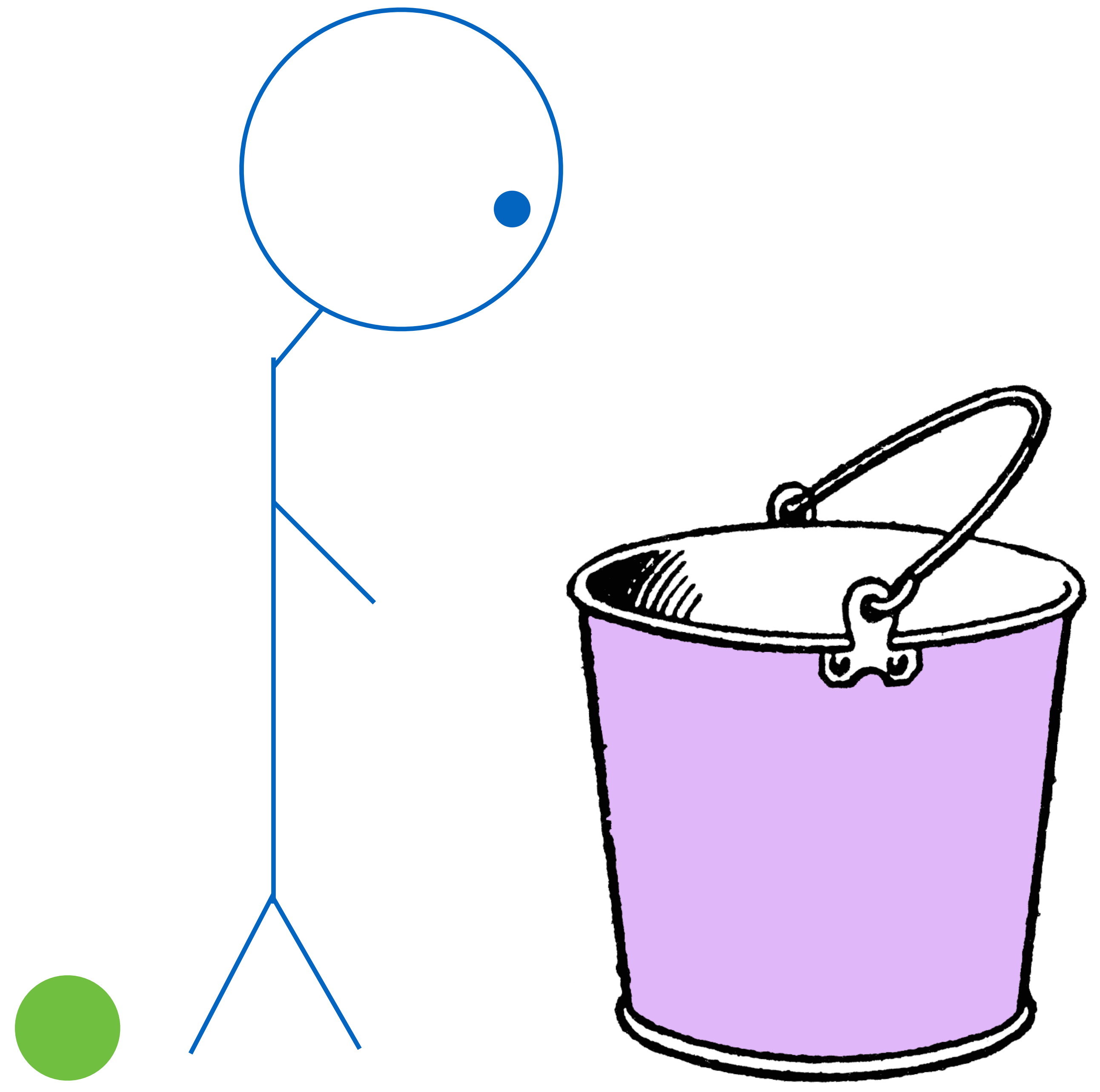
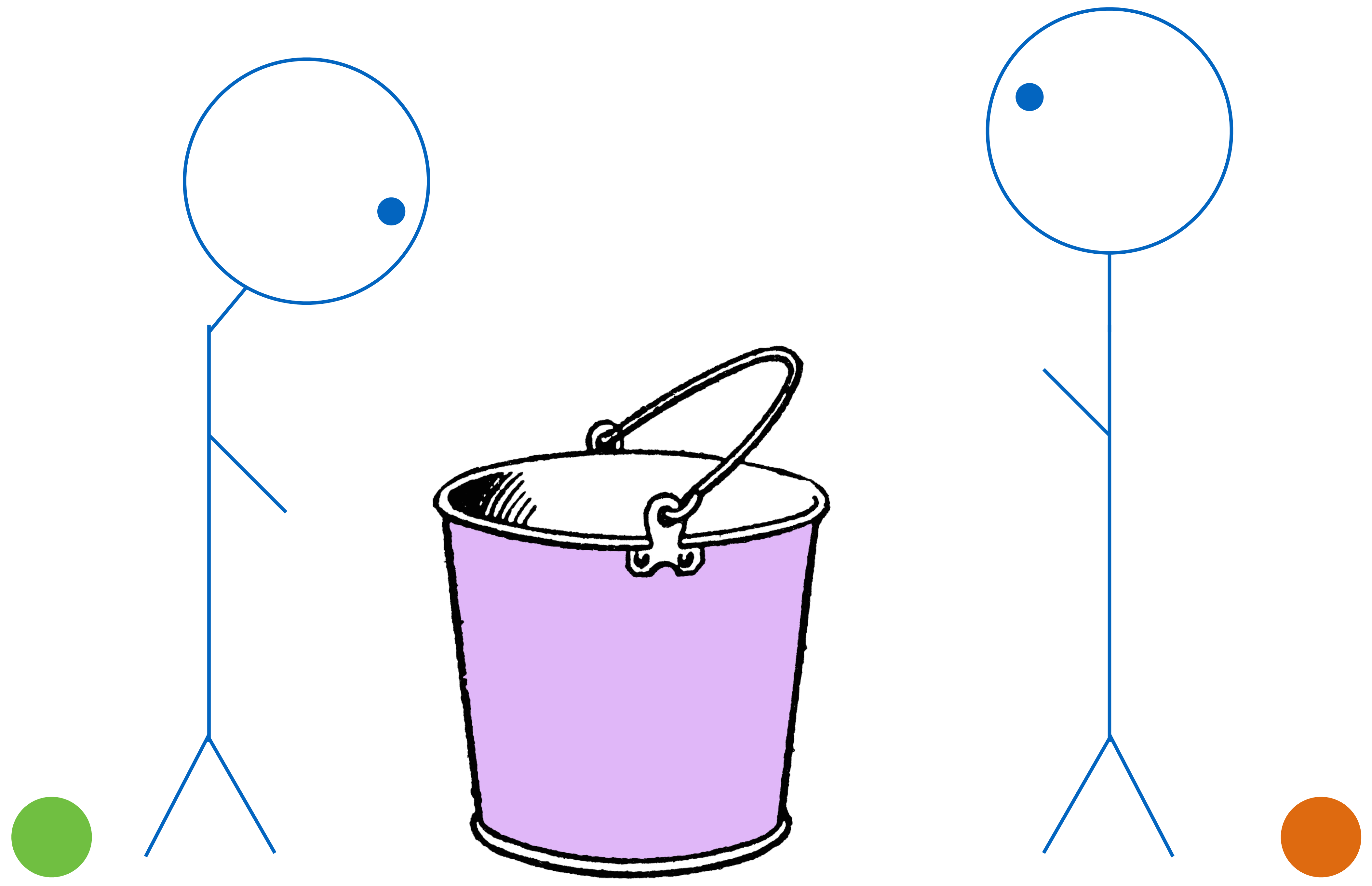


thread1 (blocked)

Semaphores

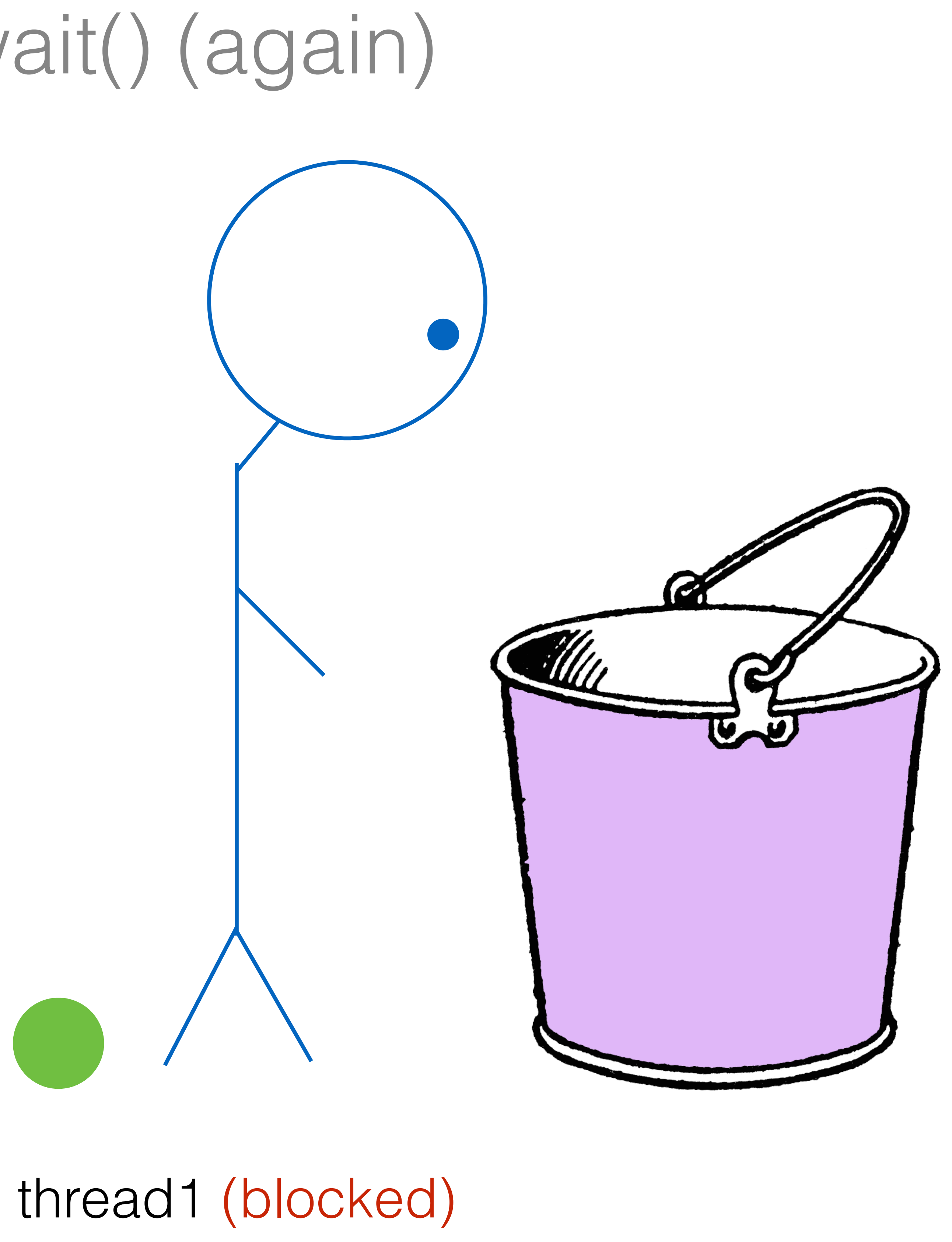
semaphore.wait() (again)

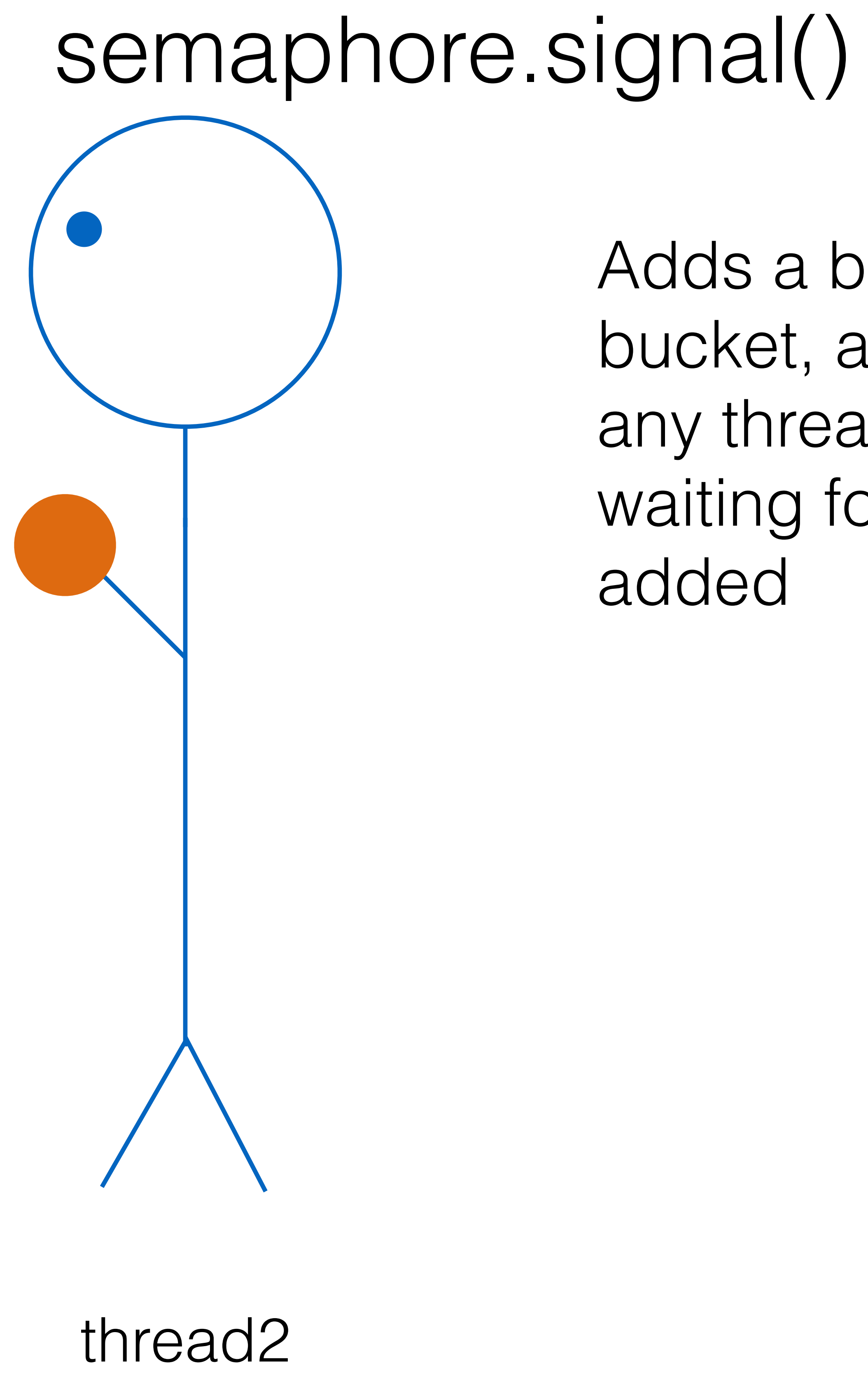


thread1 (blocked)

thread2

Semaphores



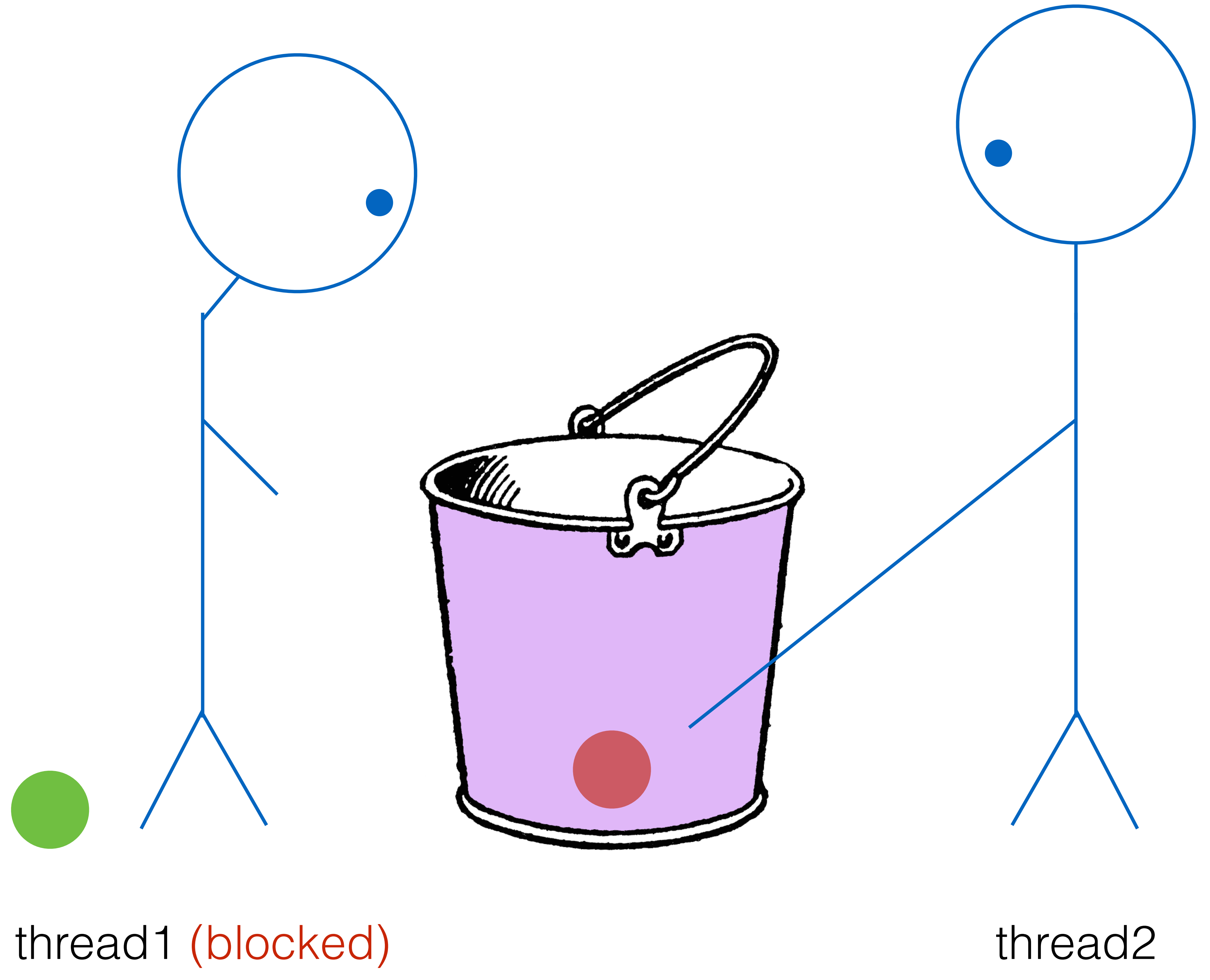


Adds a ball to the bucket, and wakes up any threads that were waiting for one to be added

Semaphores

semaphore.wait() (again)

semaphore.signal()



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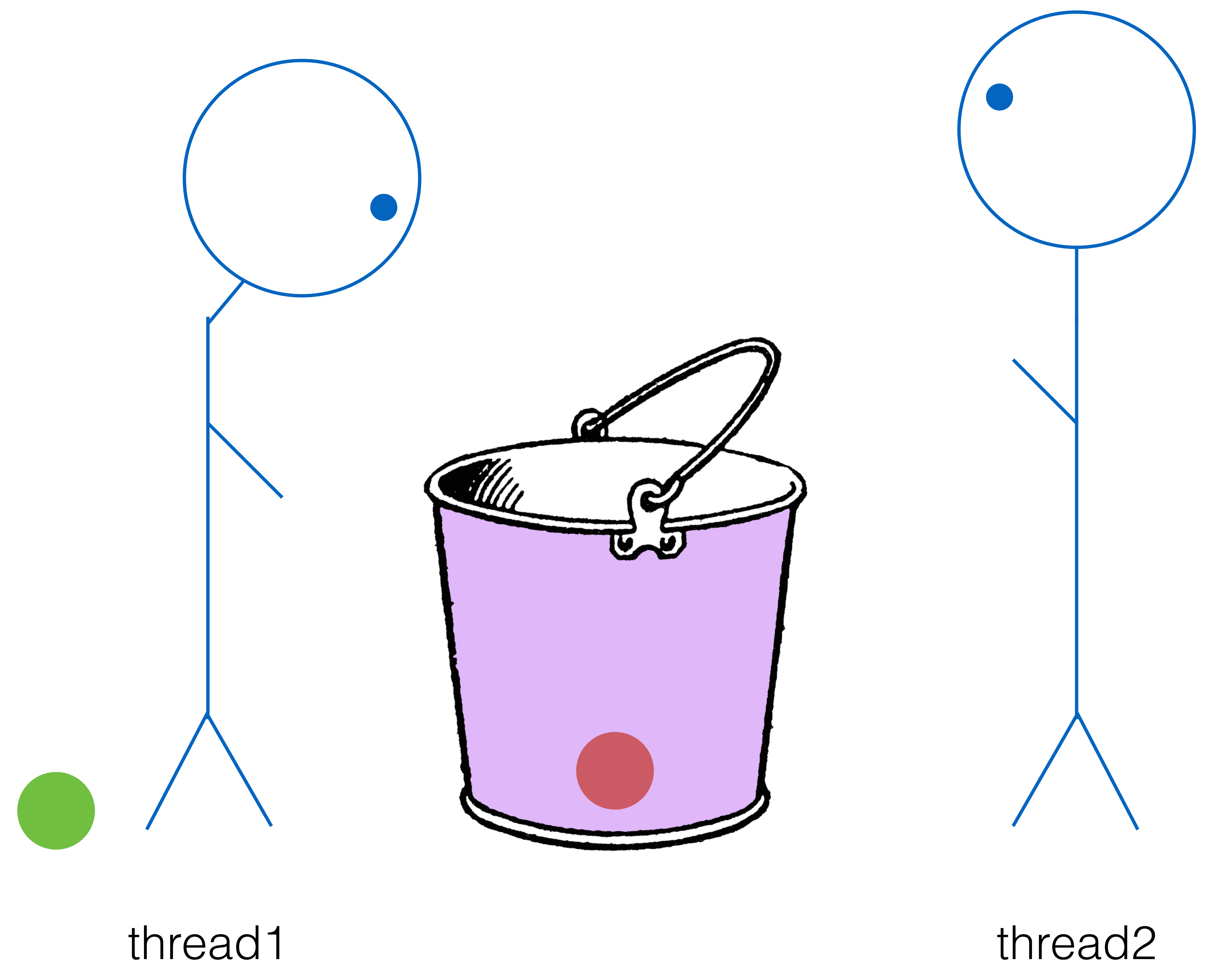
semaphore.wait() (again)



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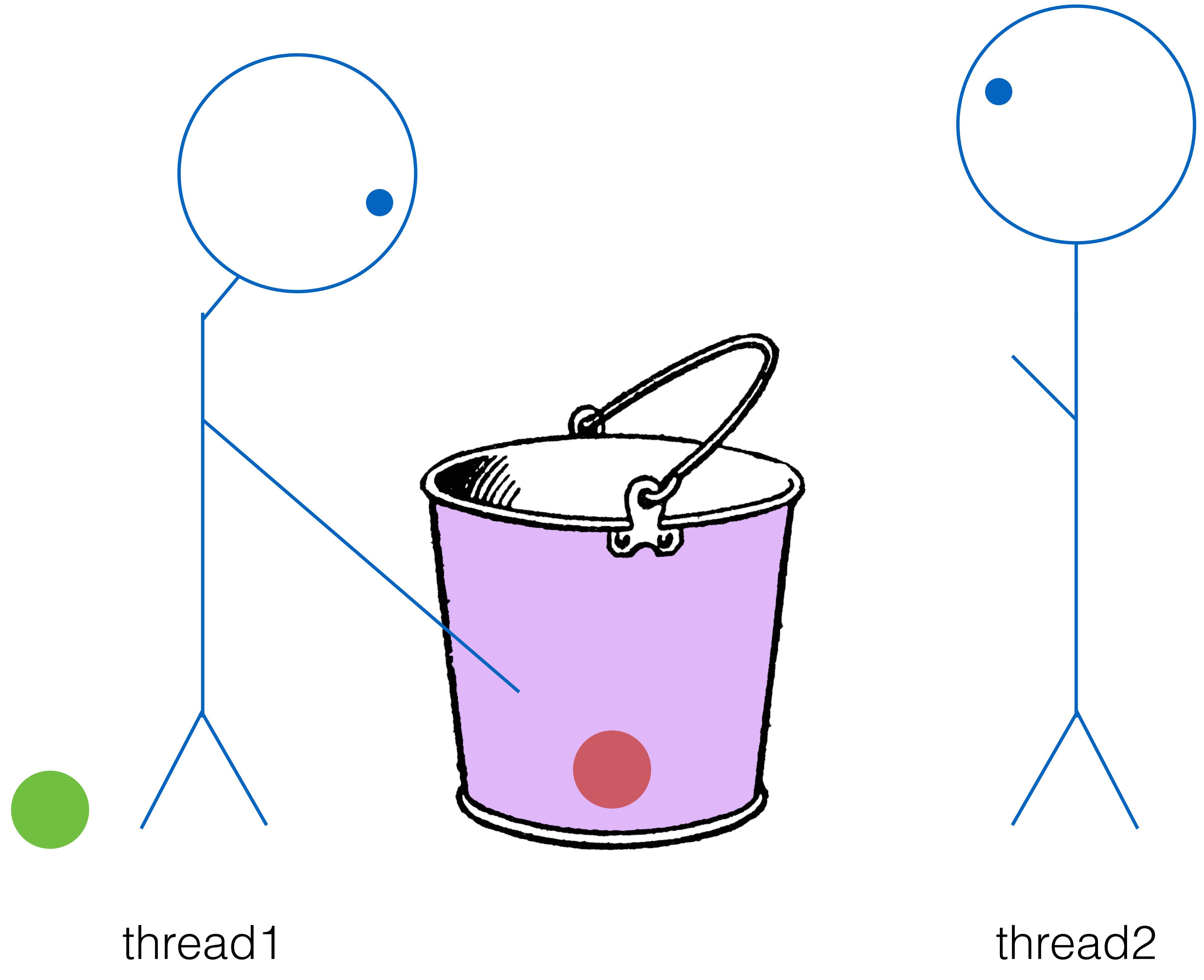
semaphore.wait() (again)



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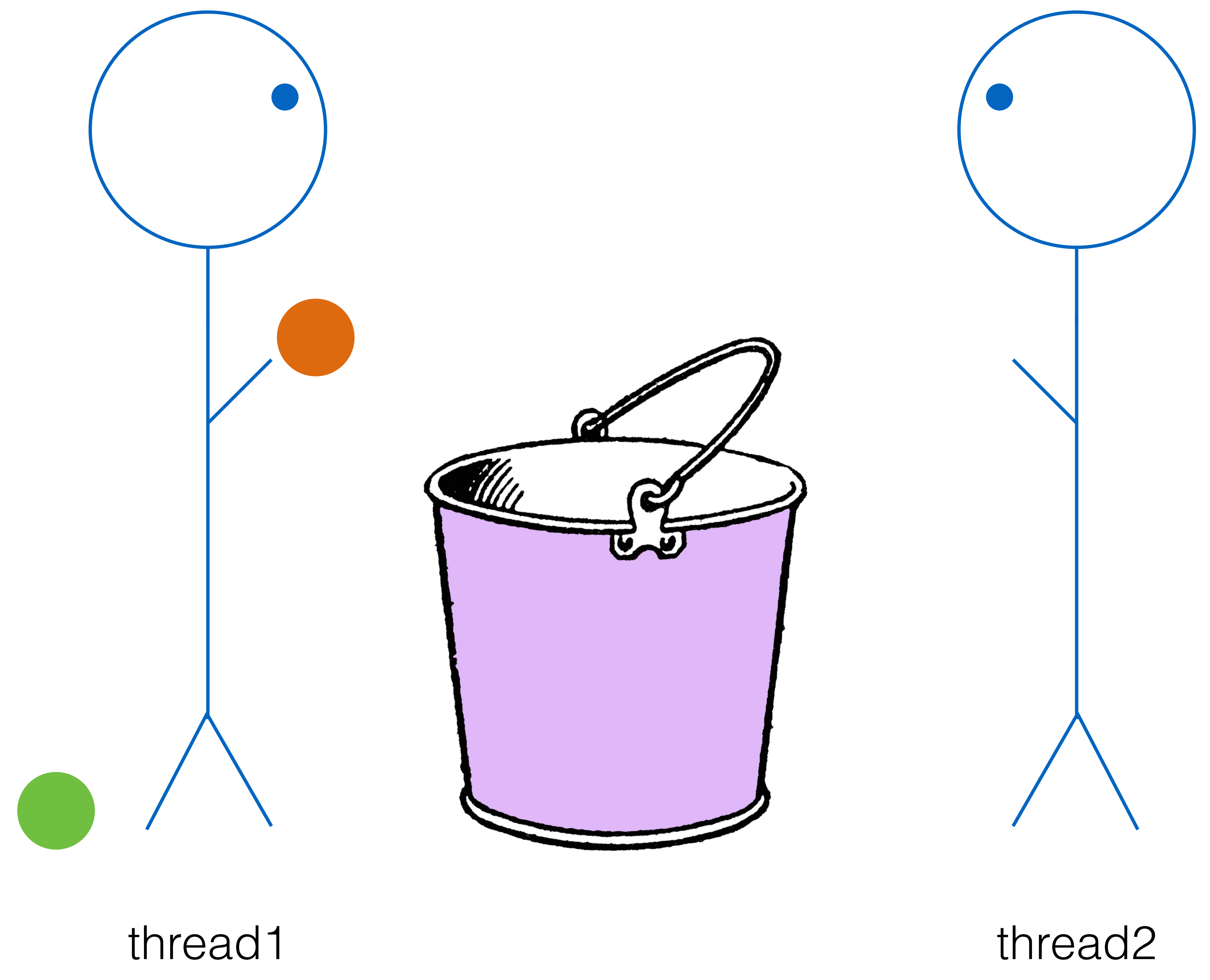
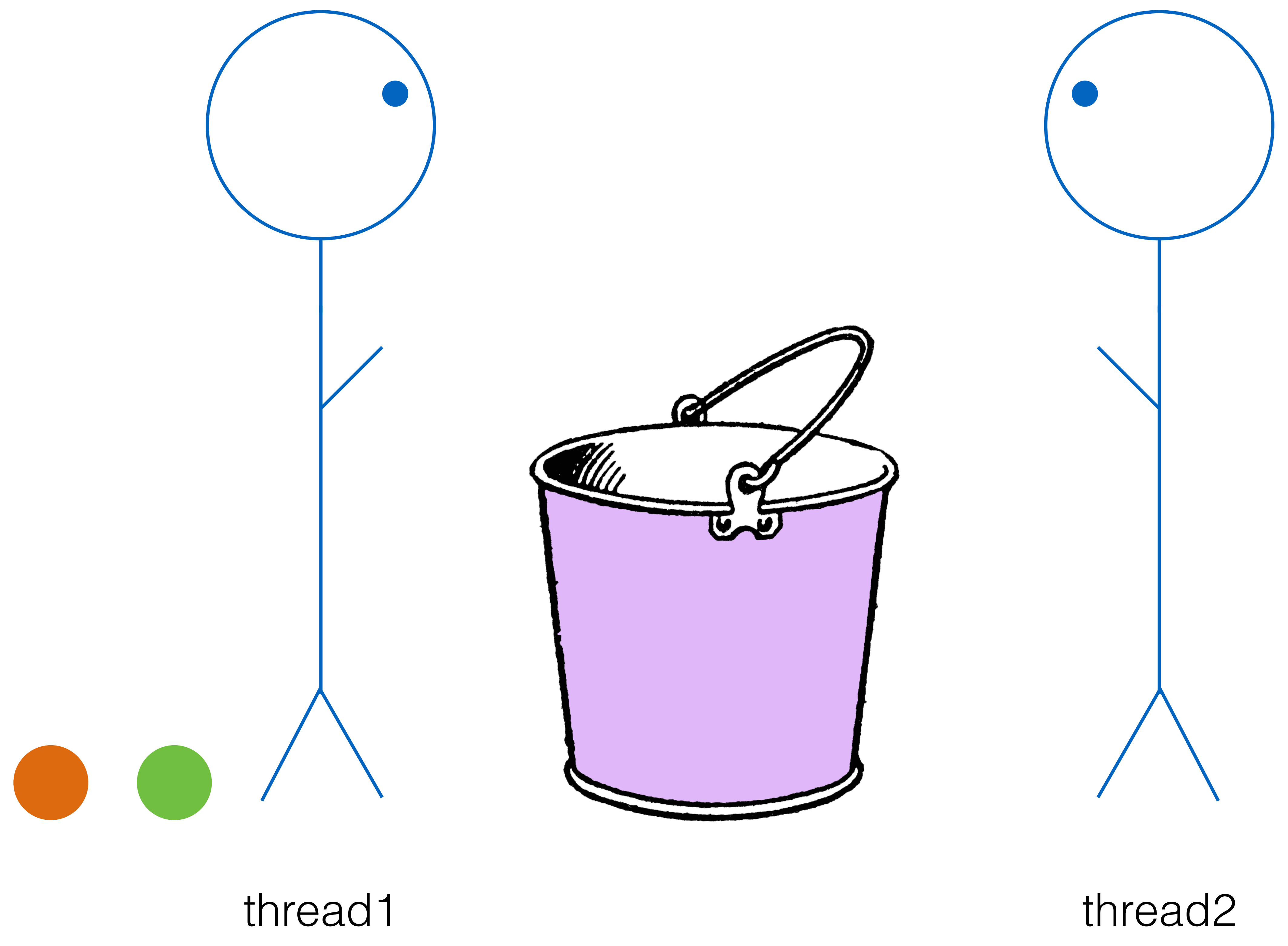
Semaphores

semaphore.wait() (again)



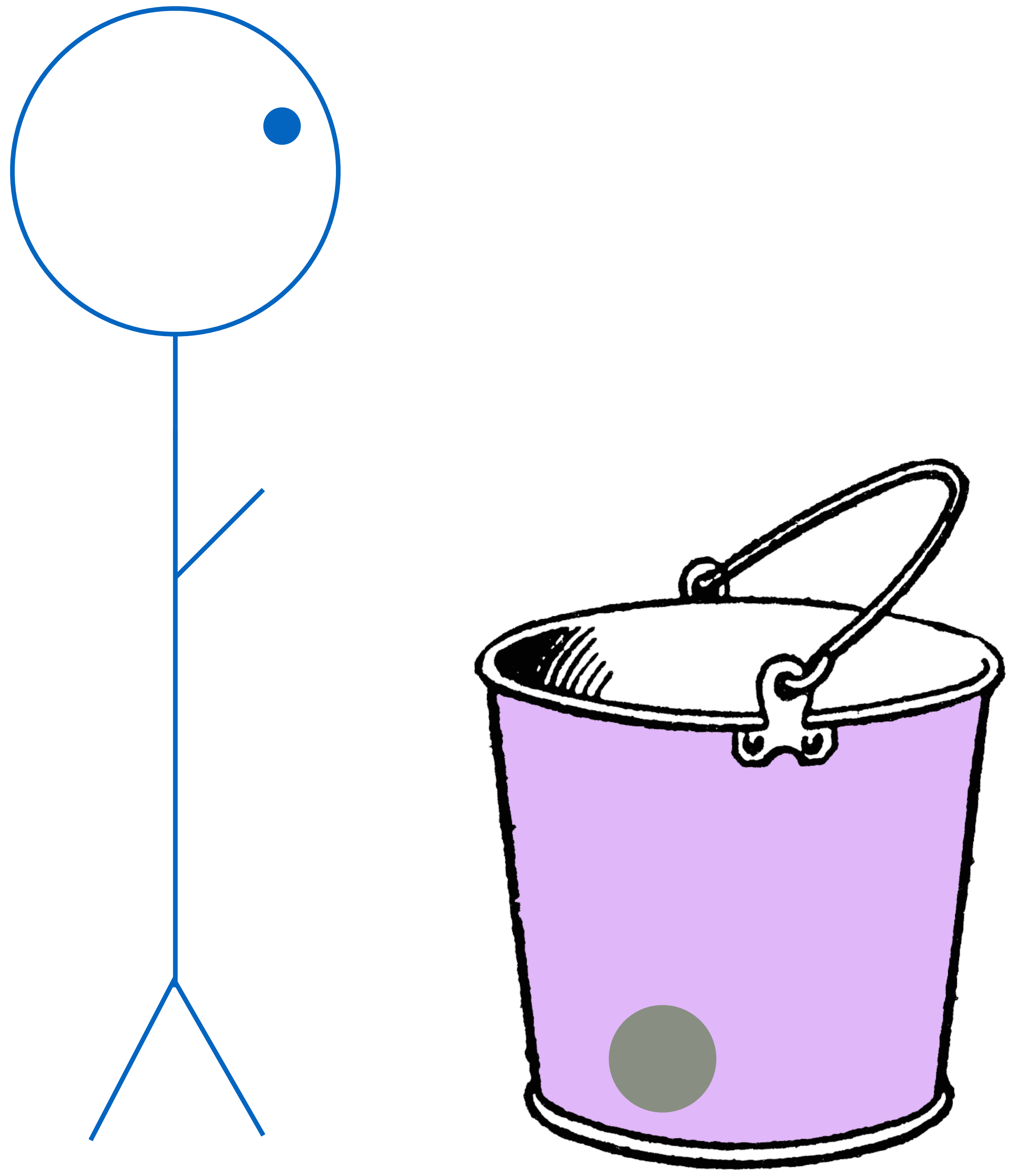
Semaphores



Semaphore methods

- signal():
  - Adds a ball to the bucket
  - **Never blocks**
- wait():
  - If a ball is in the bucket, takes the ball and returns immediately
  - If no ball is in the bucket, waits until one is available, then takes the ball and returns
- There isn’t anything *actually* stored in the bucket. (Under the hood, semaphores are implemented with a simple counter indicating how many “balls” (or whatever) are in the bucket.) But they are very useful for synchronizing between threads

Producer-consumer: transferring data between threads



Mutex: Unlocked

Buffer:

SomeStruct { … }			

Producer-consumer: transferring data between threads

semaphore.wait()
thread1

Mutex: Unlocked

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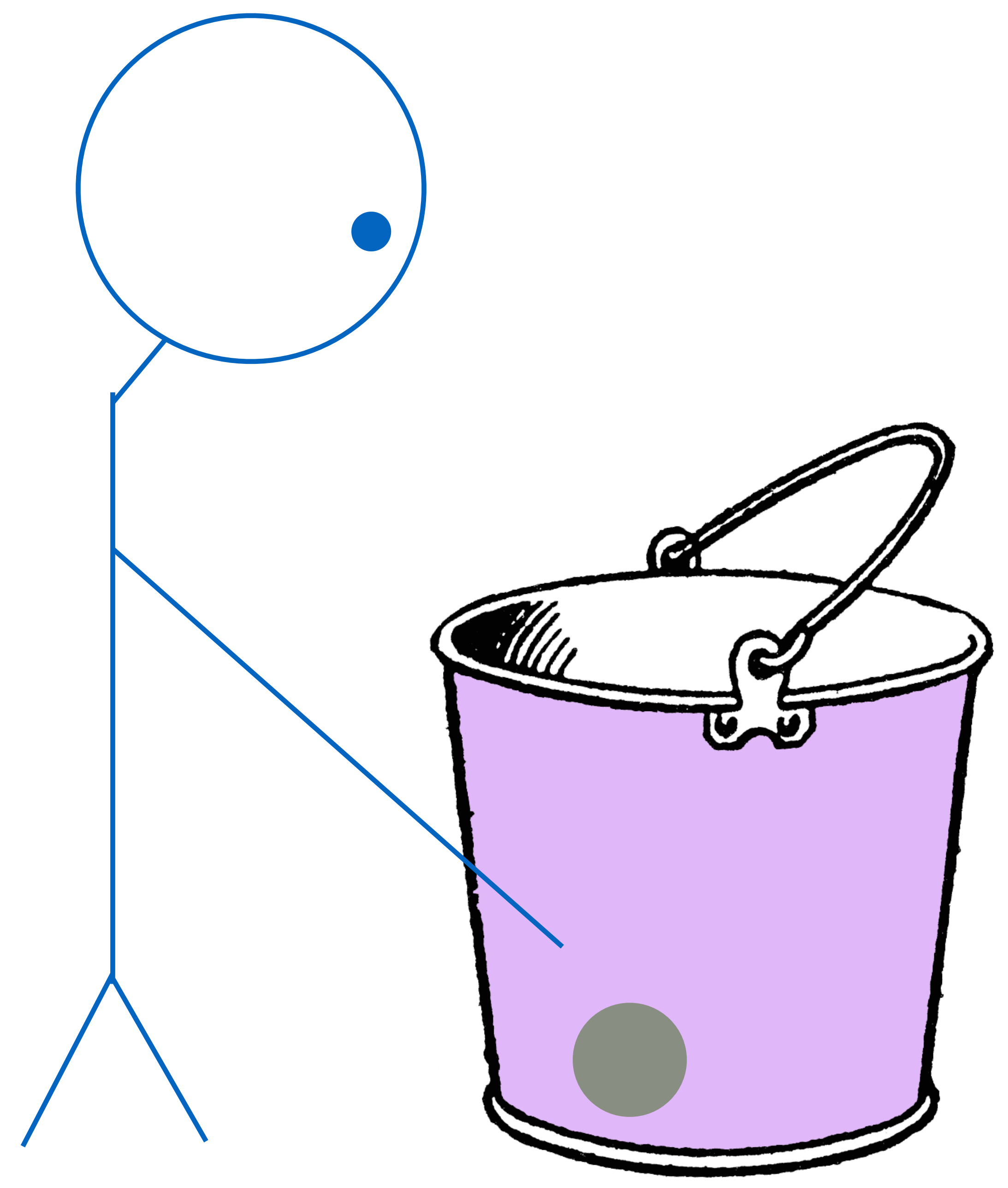
semaphore.wait()



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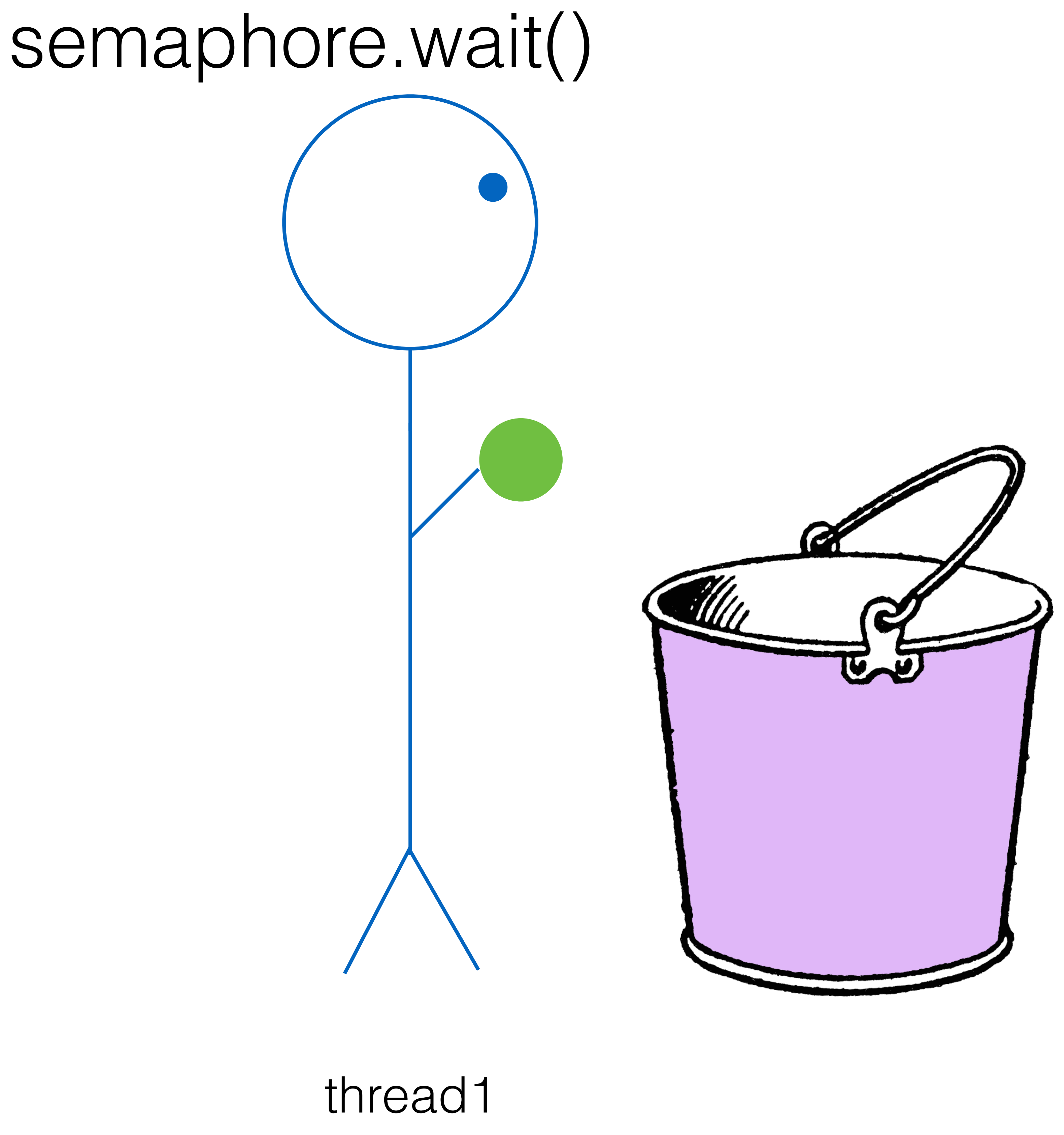

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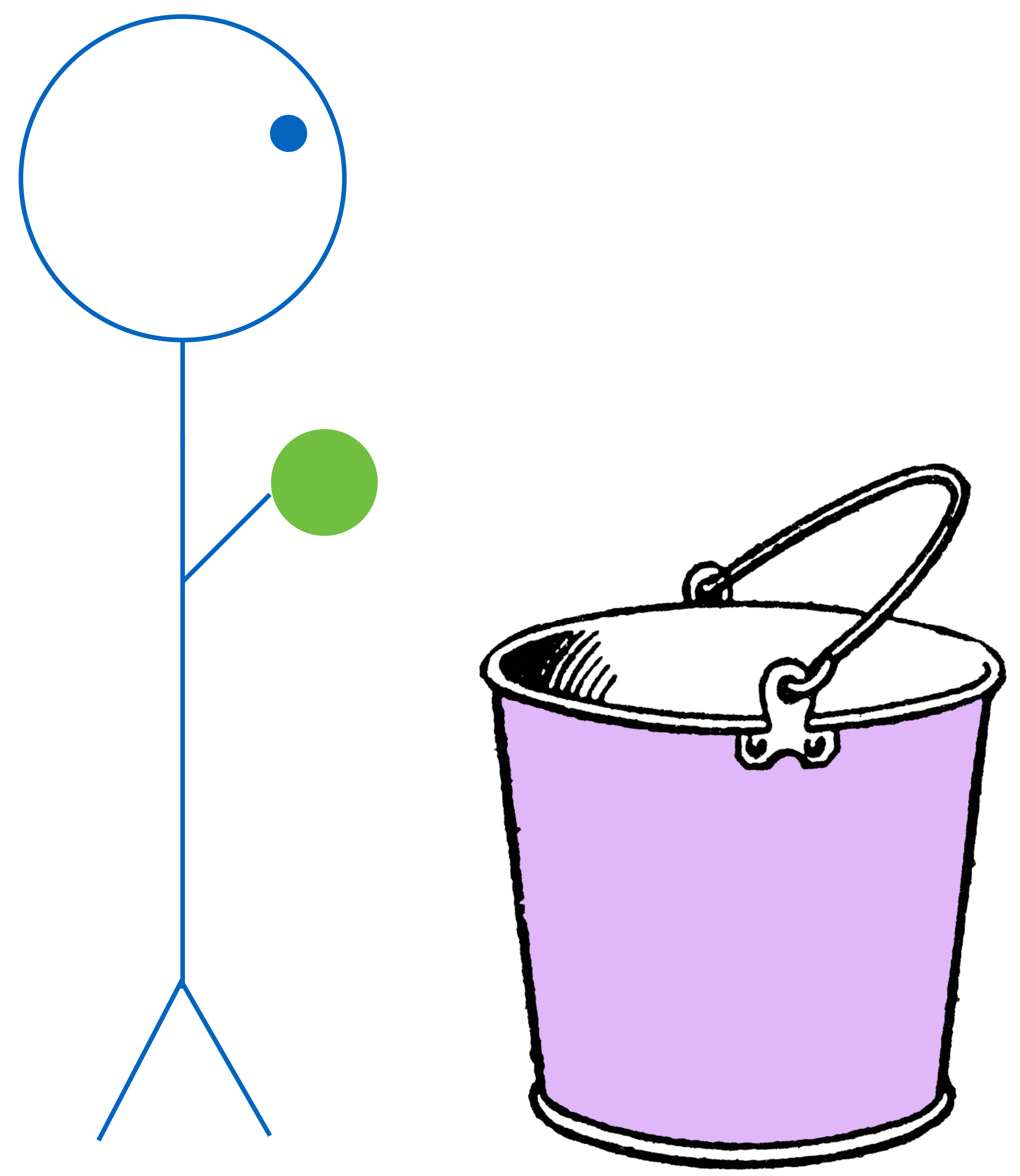

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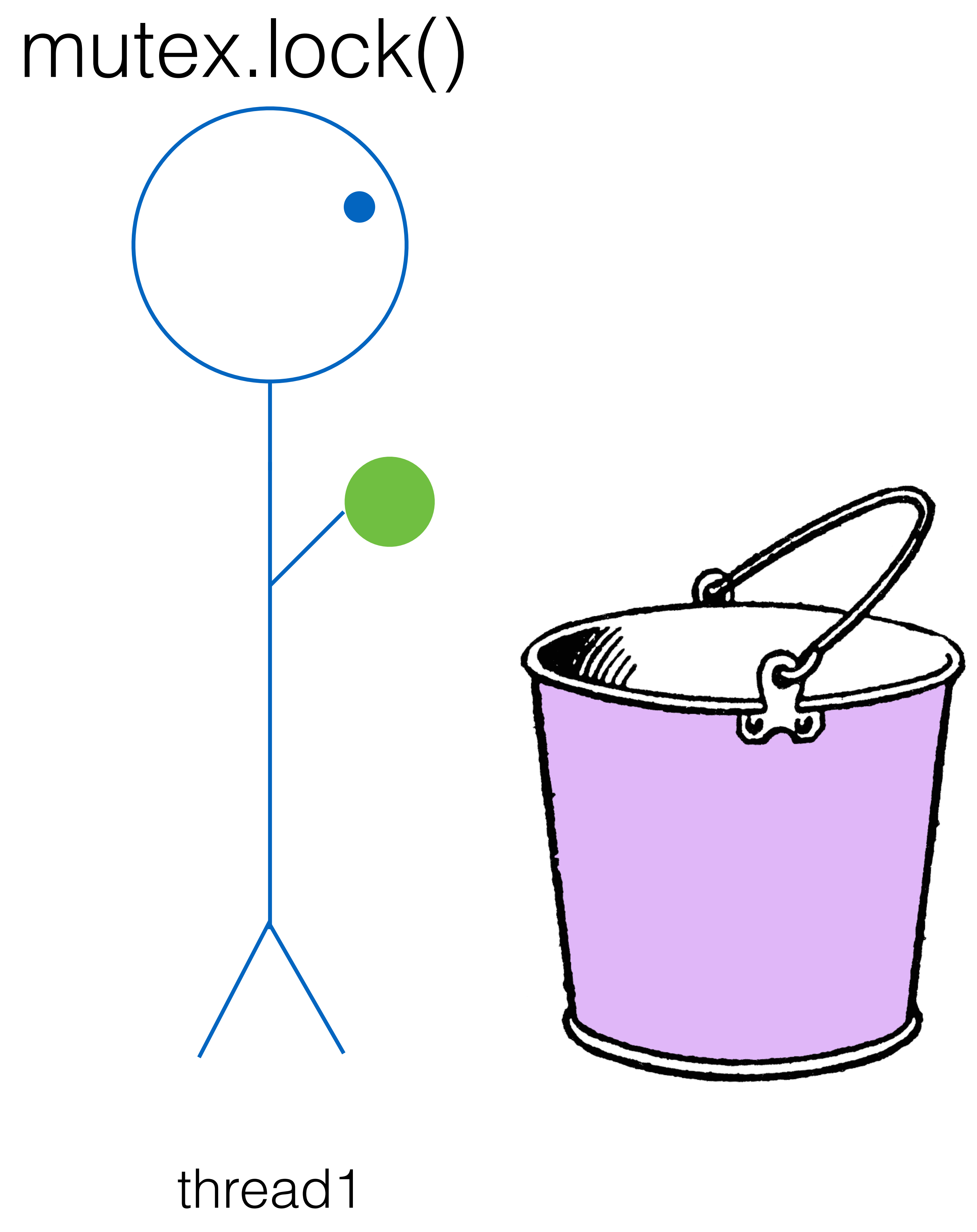

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Producer-consumer: transferring data between threads

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    ...
}
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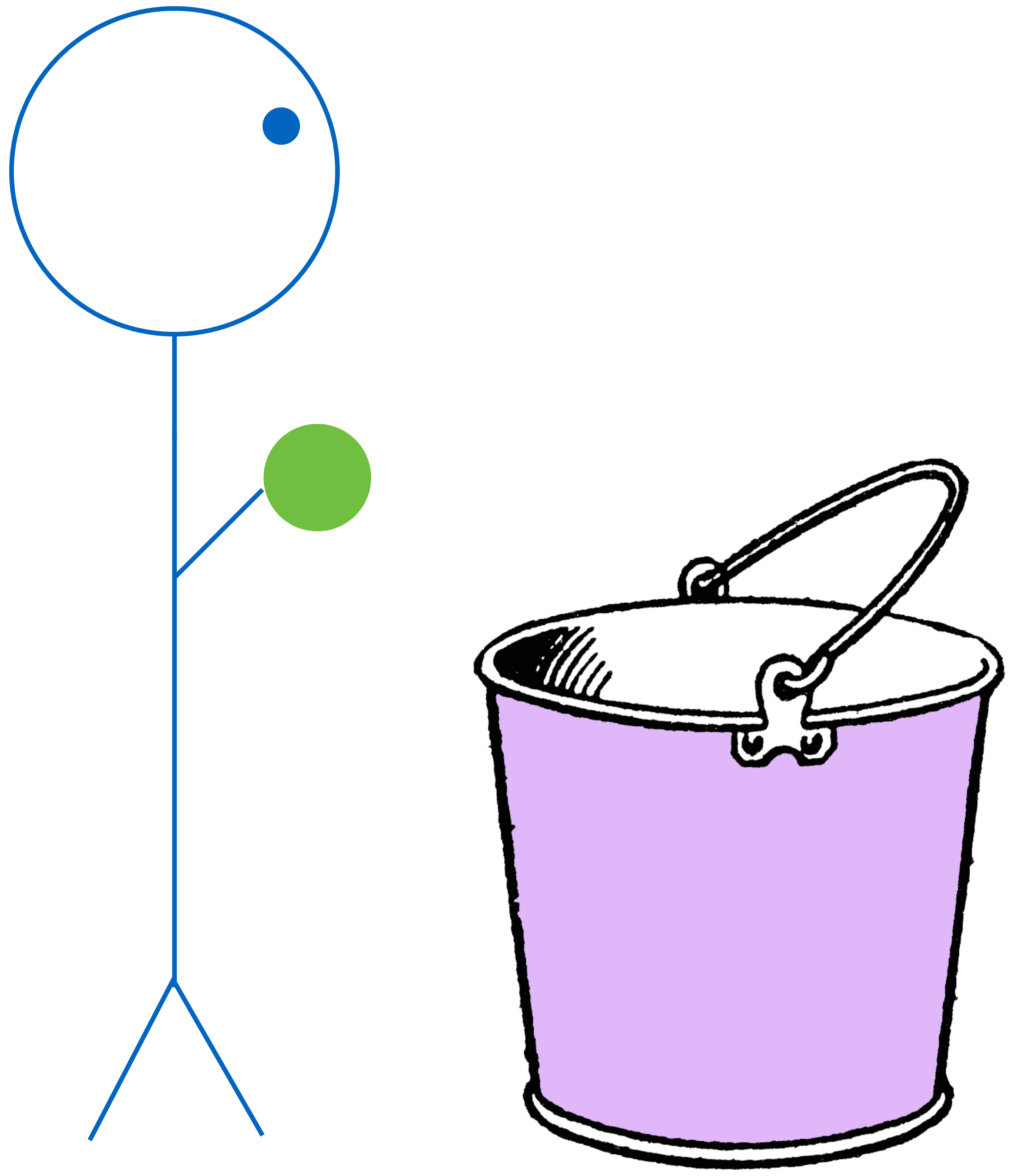

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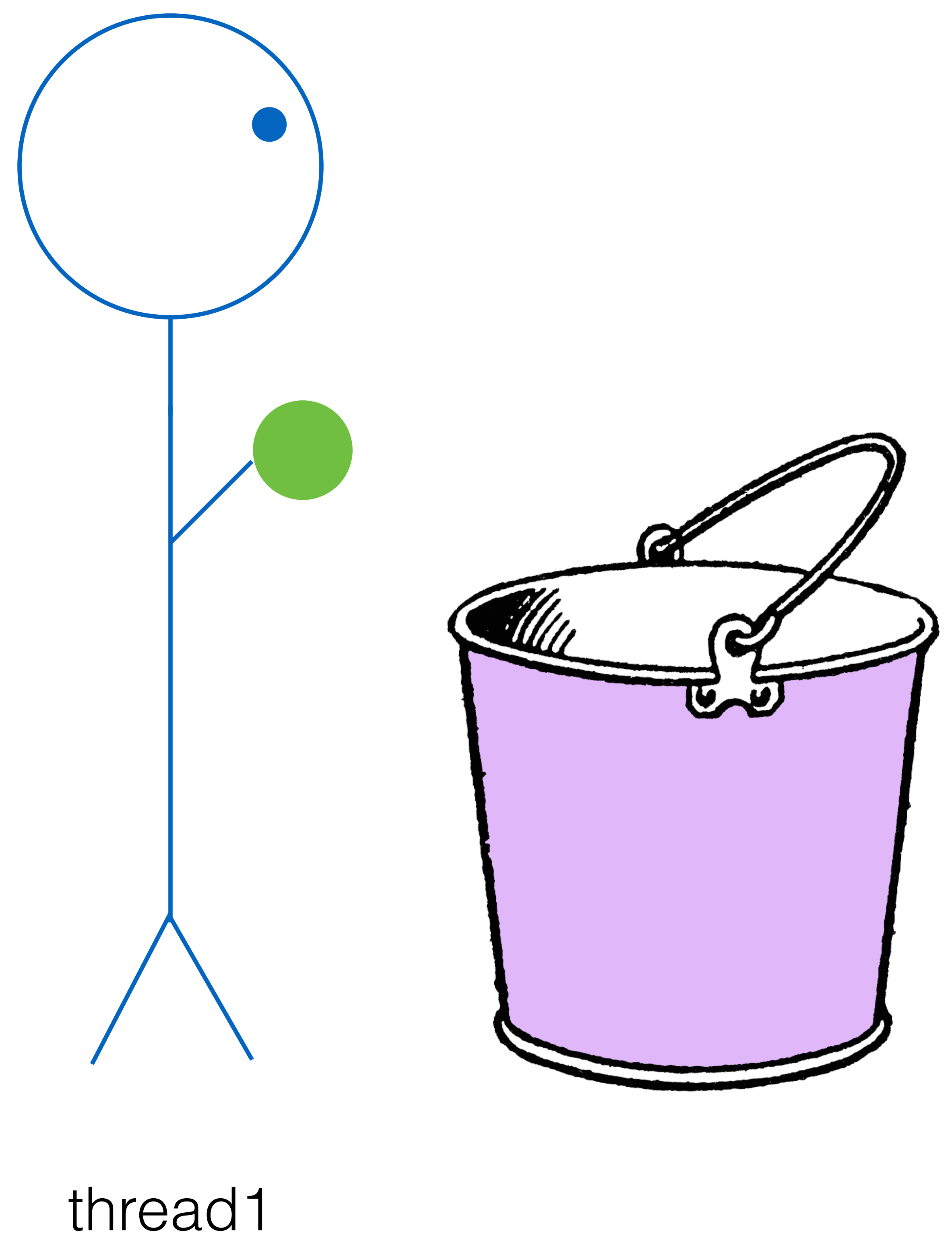

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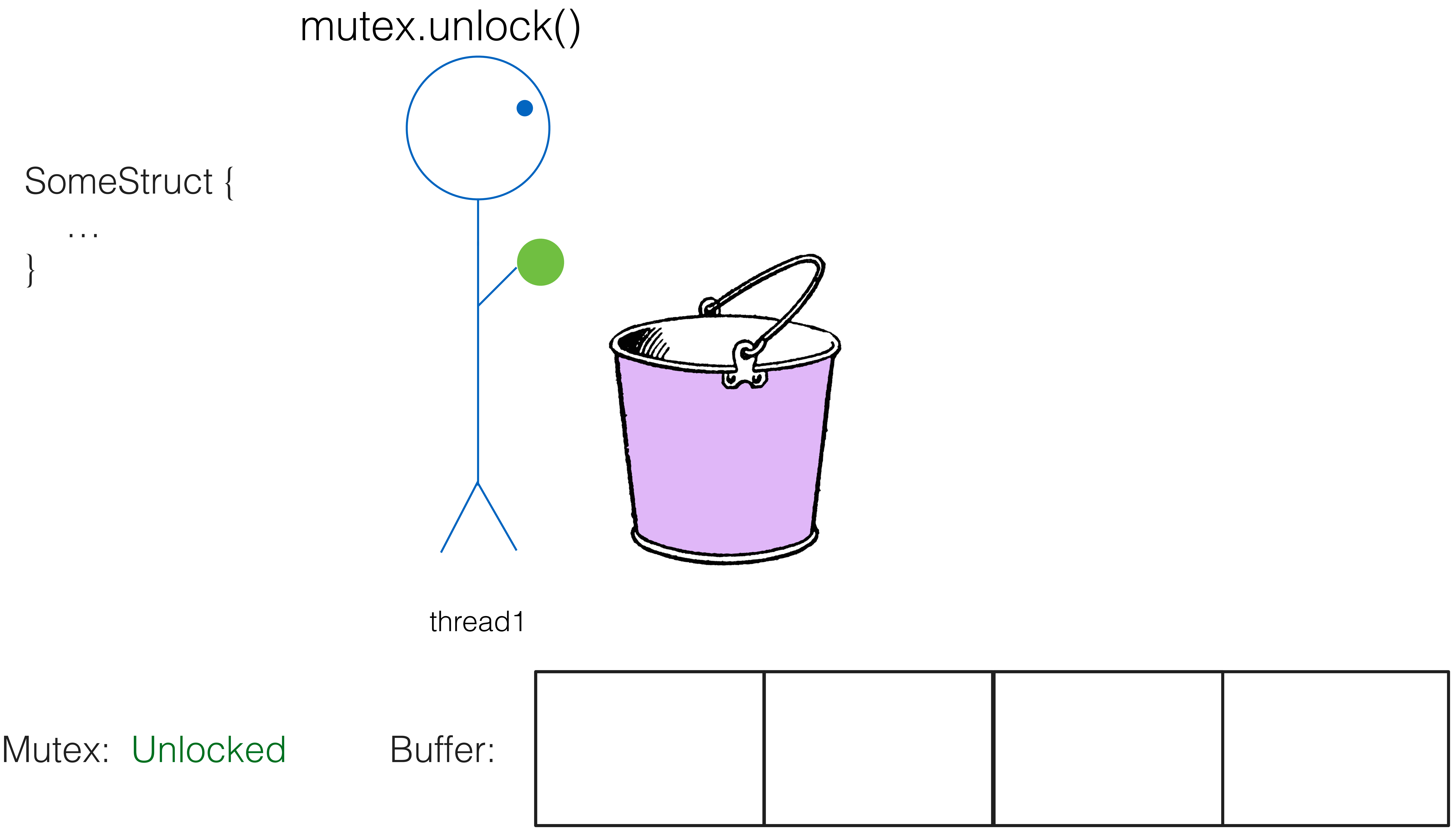

Producer-consumer: transferring data between threads

semaphore.wait() (again)

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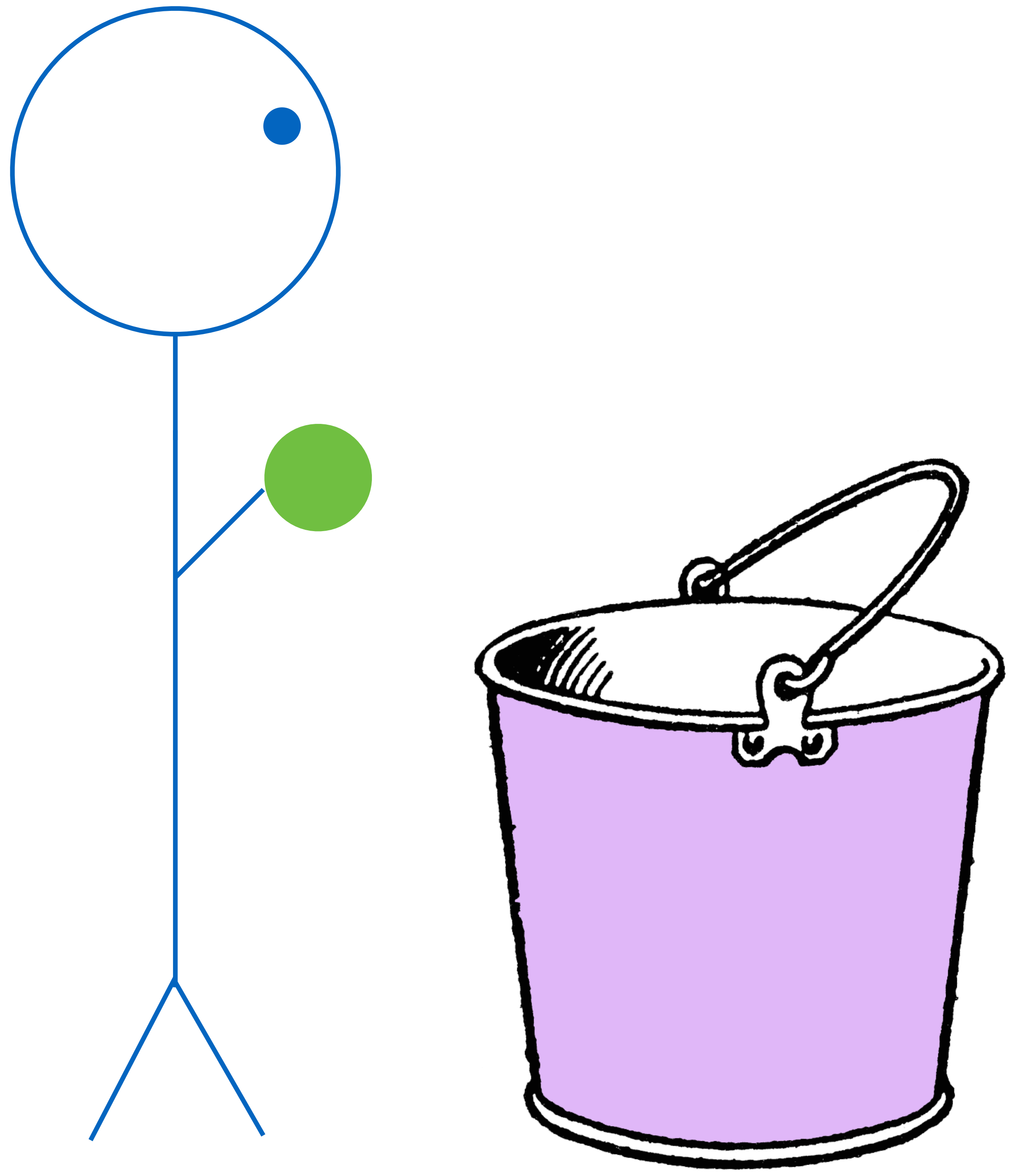

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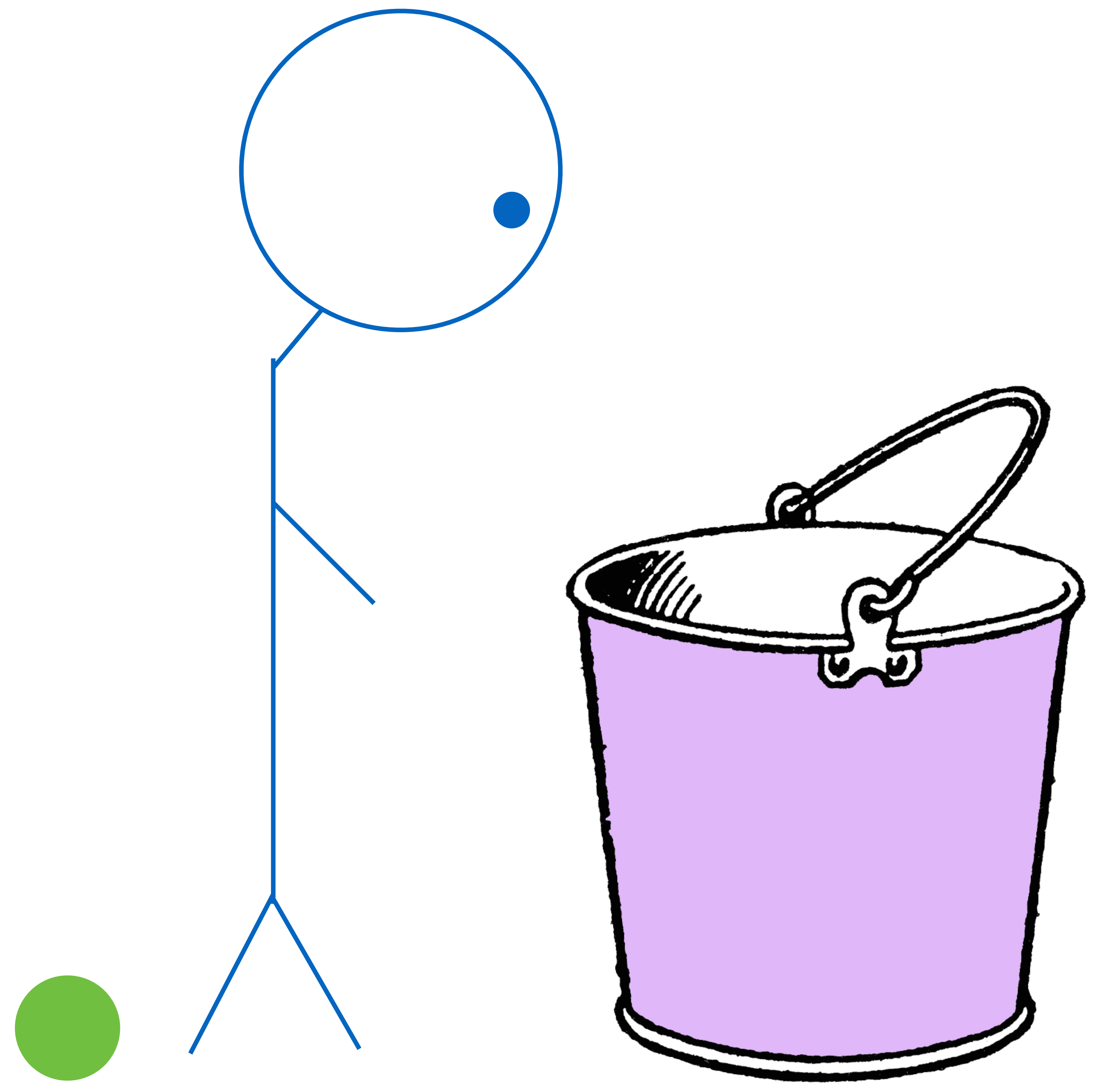

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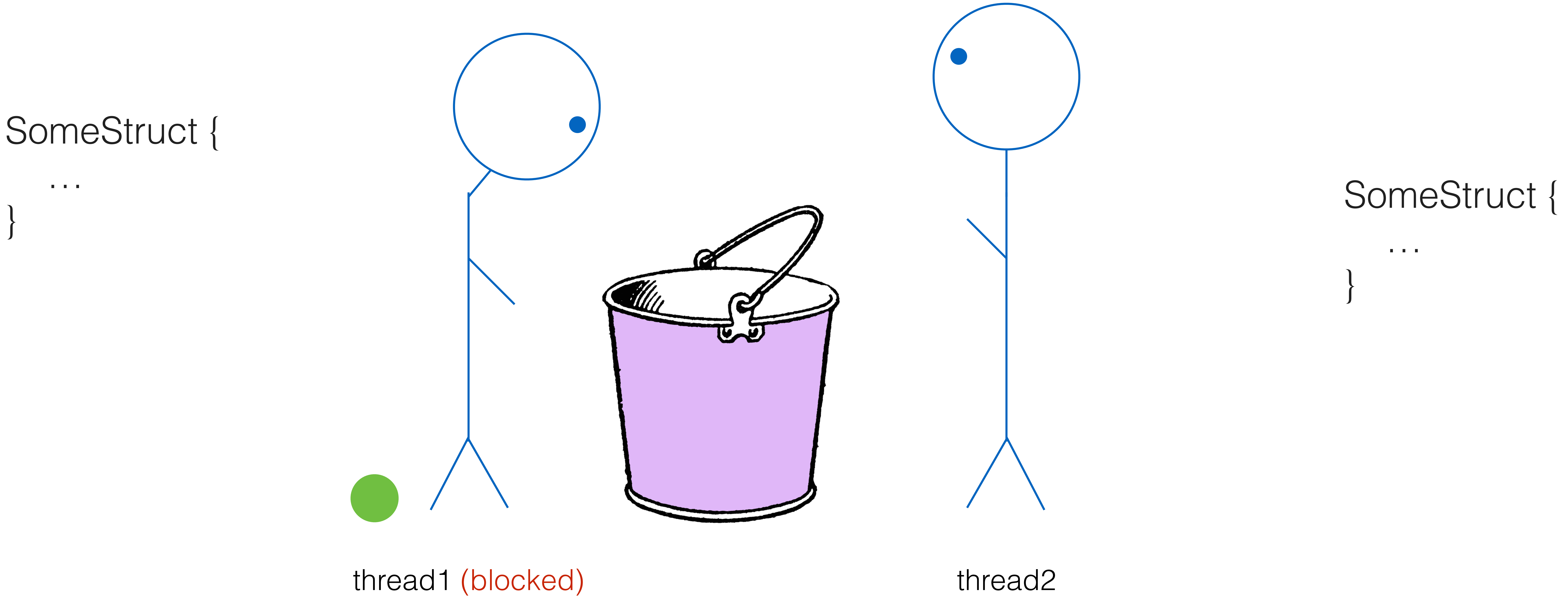

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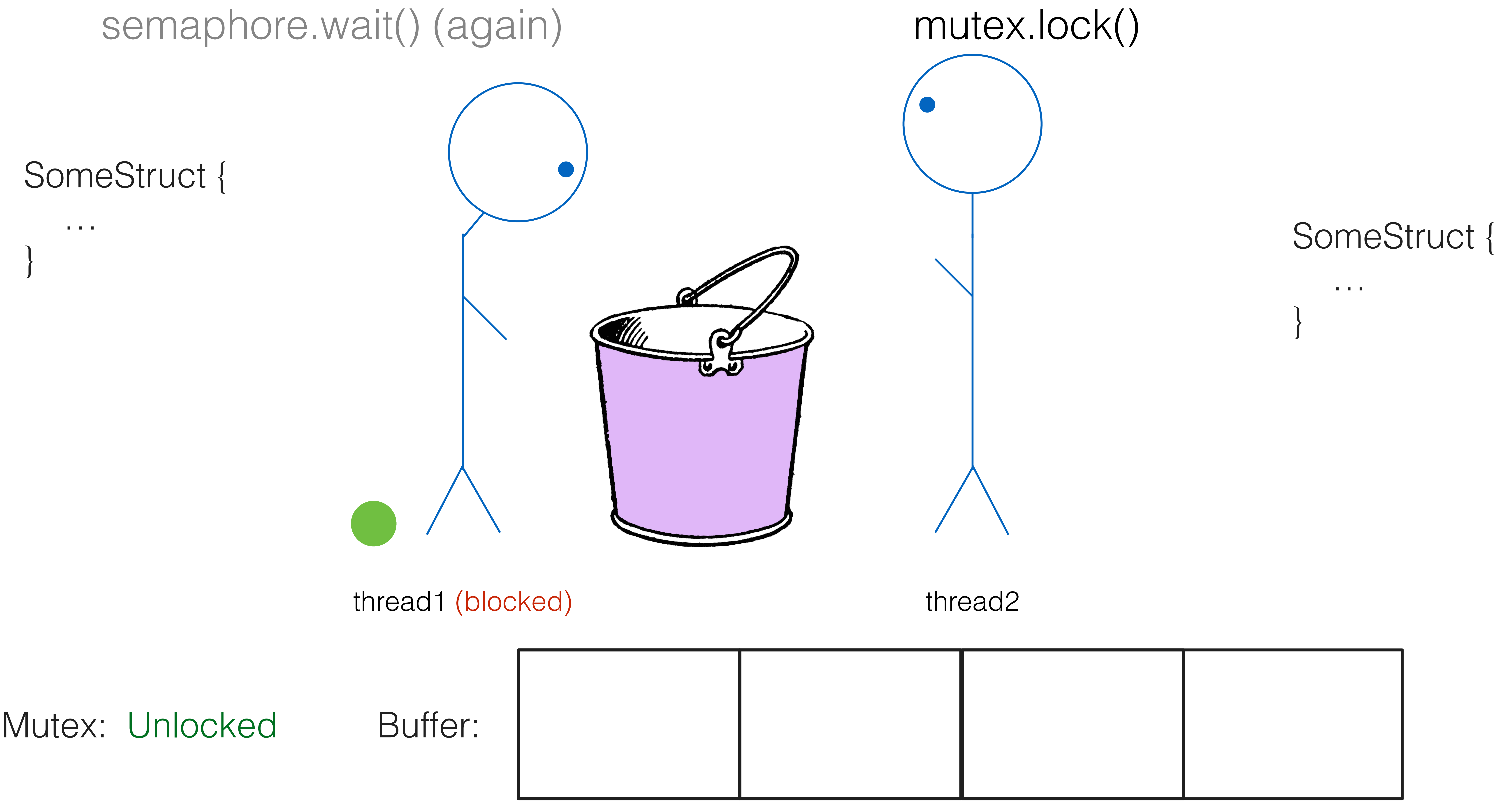

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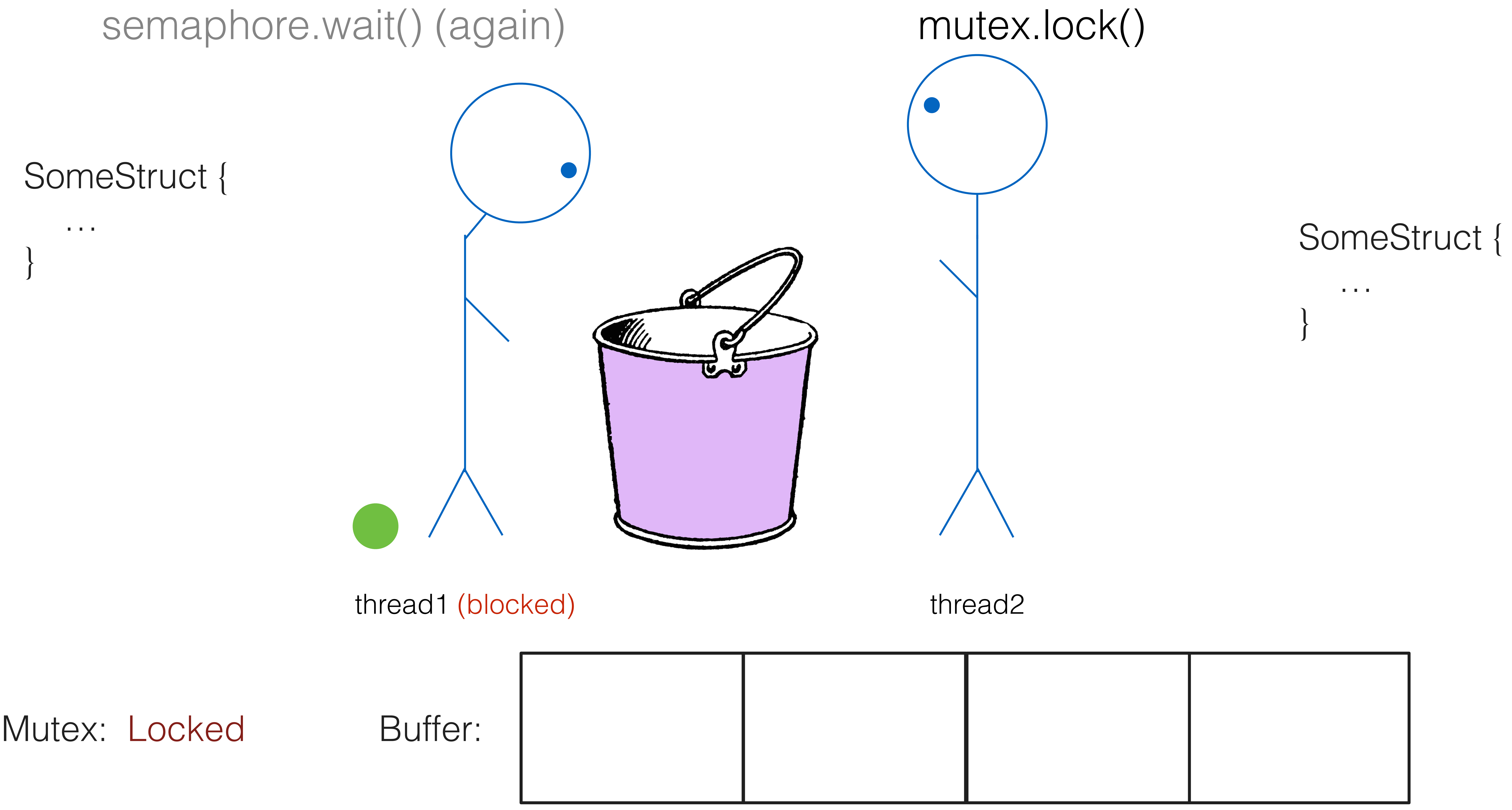

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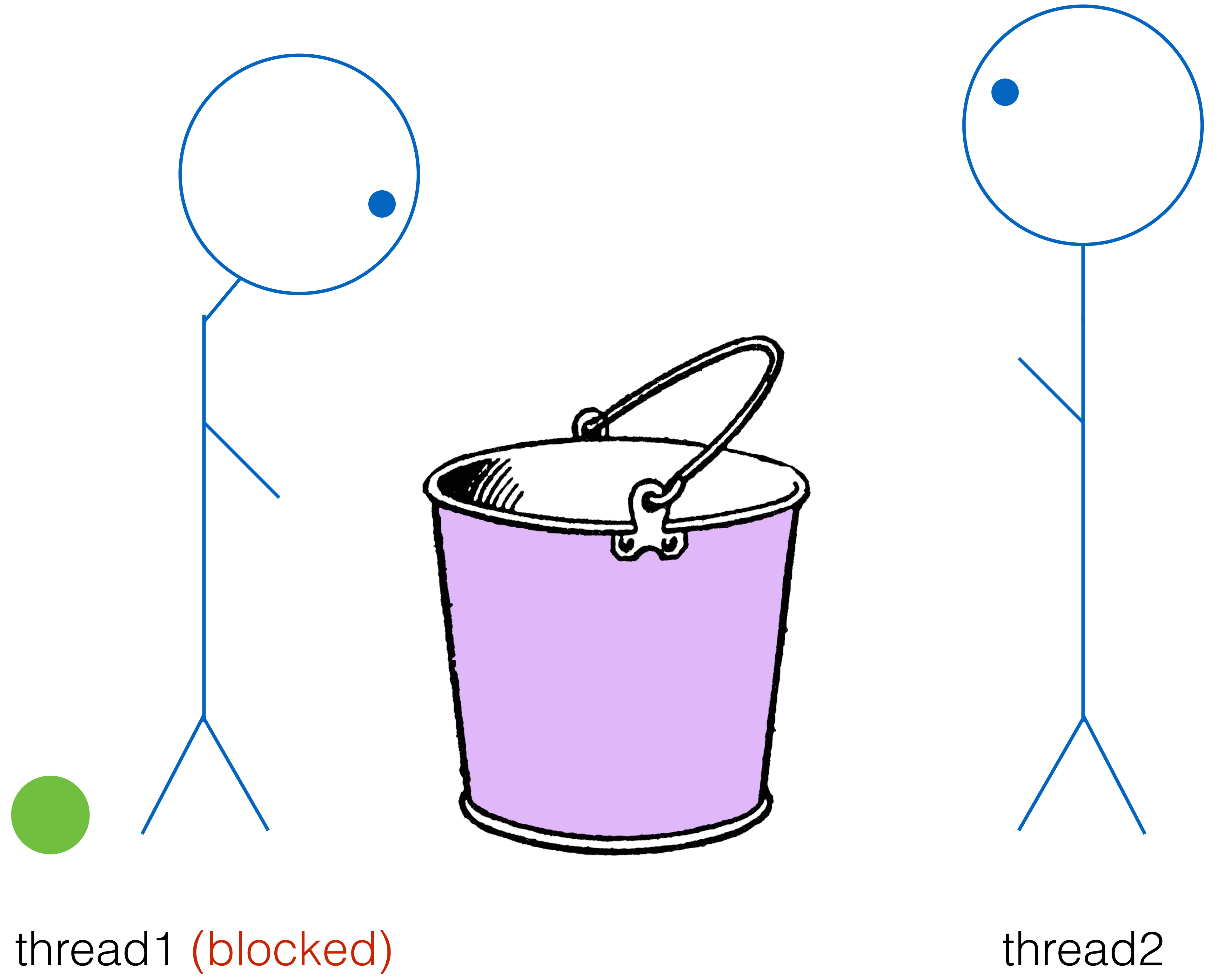

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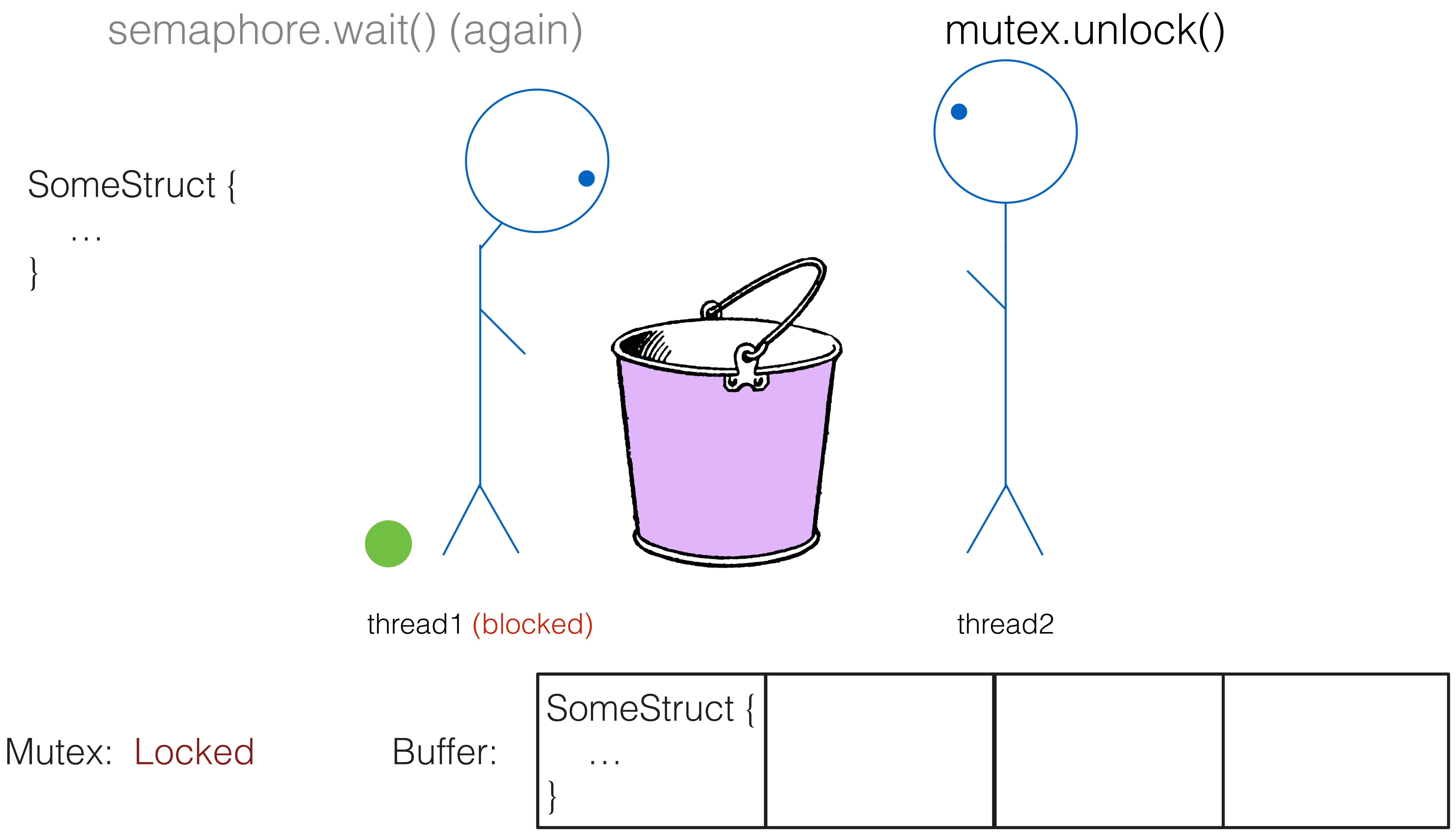

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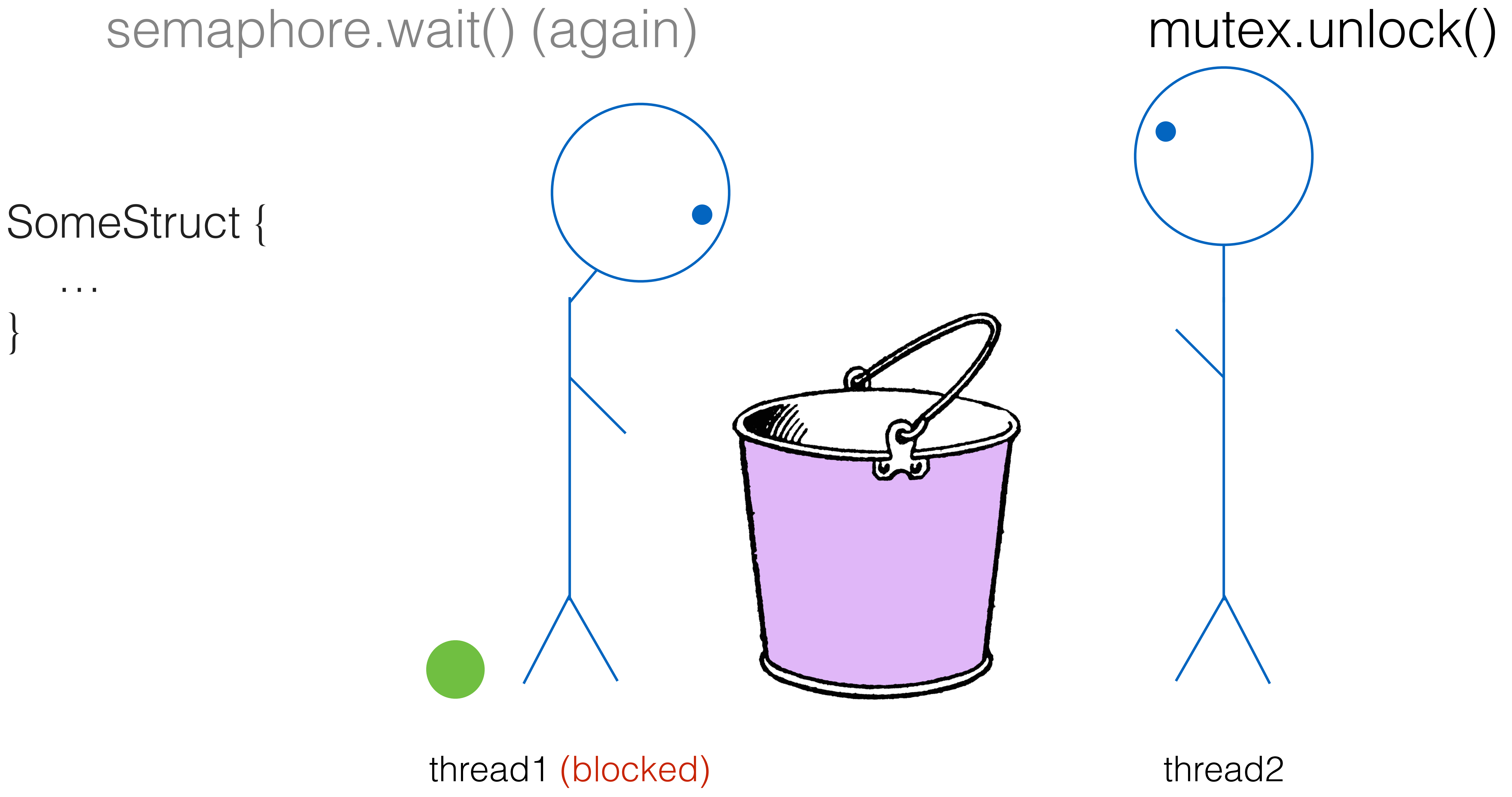

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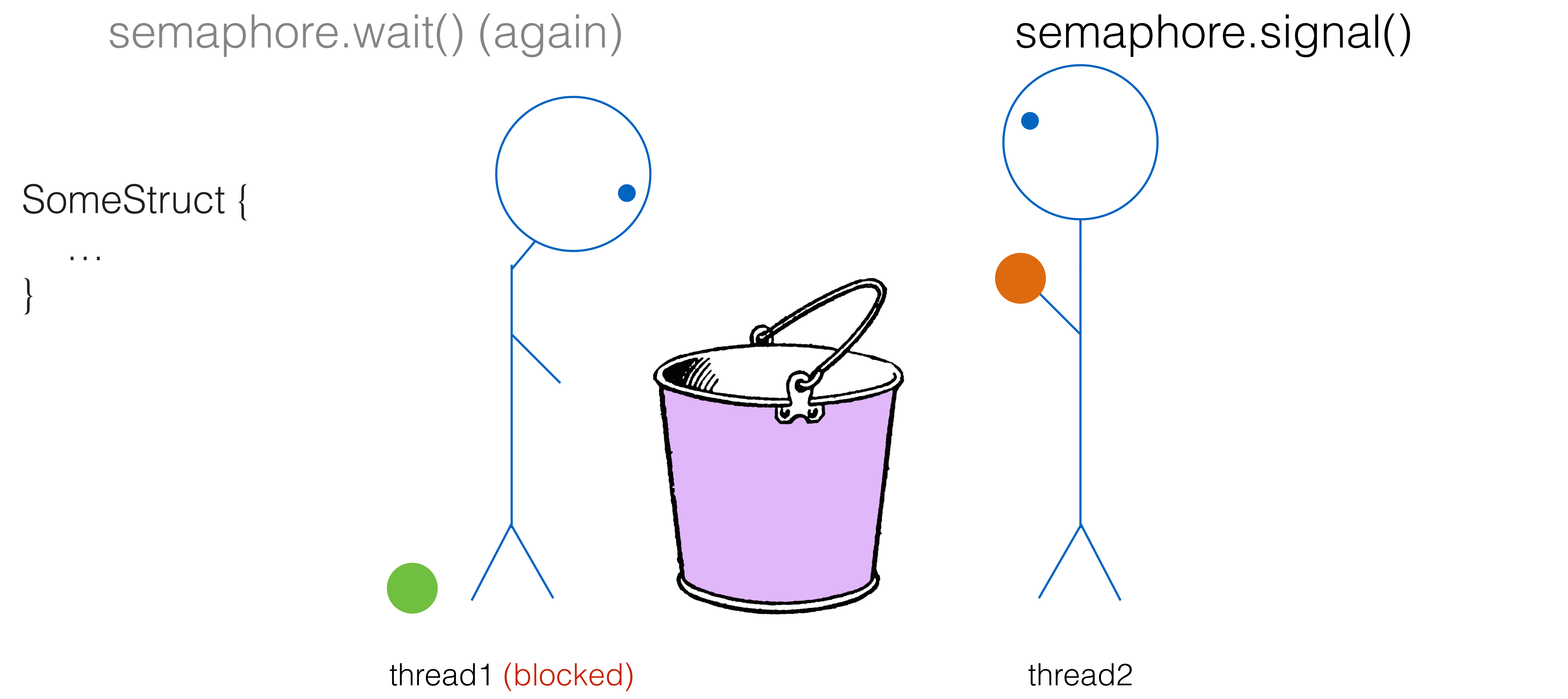

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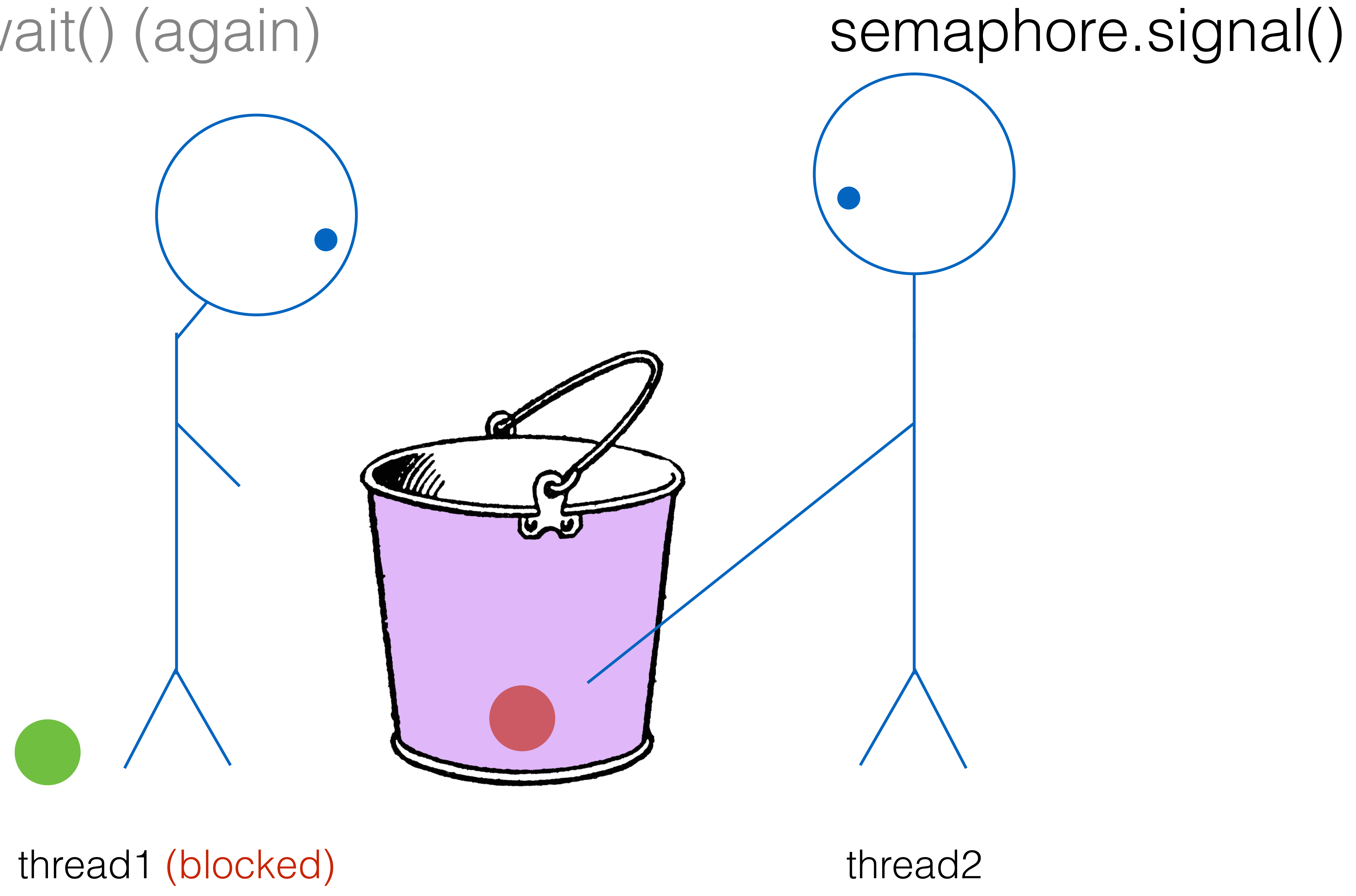

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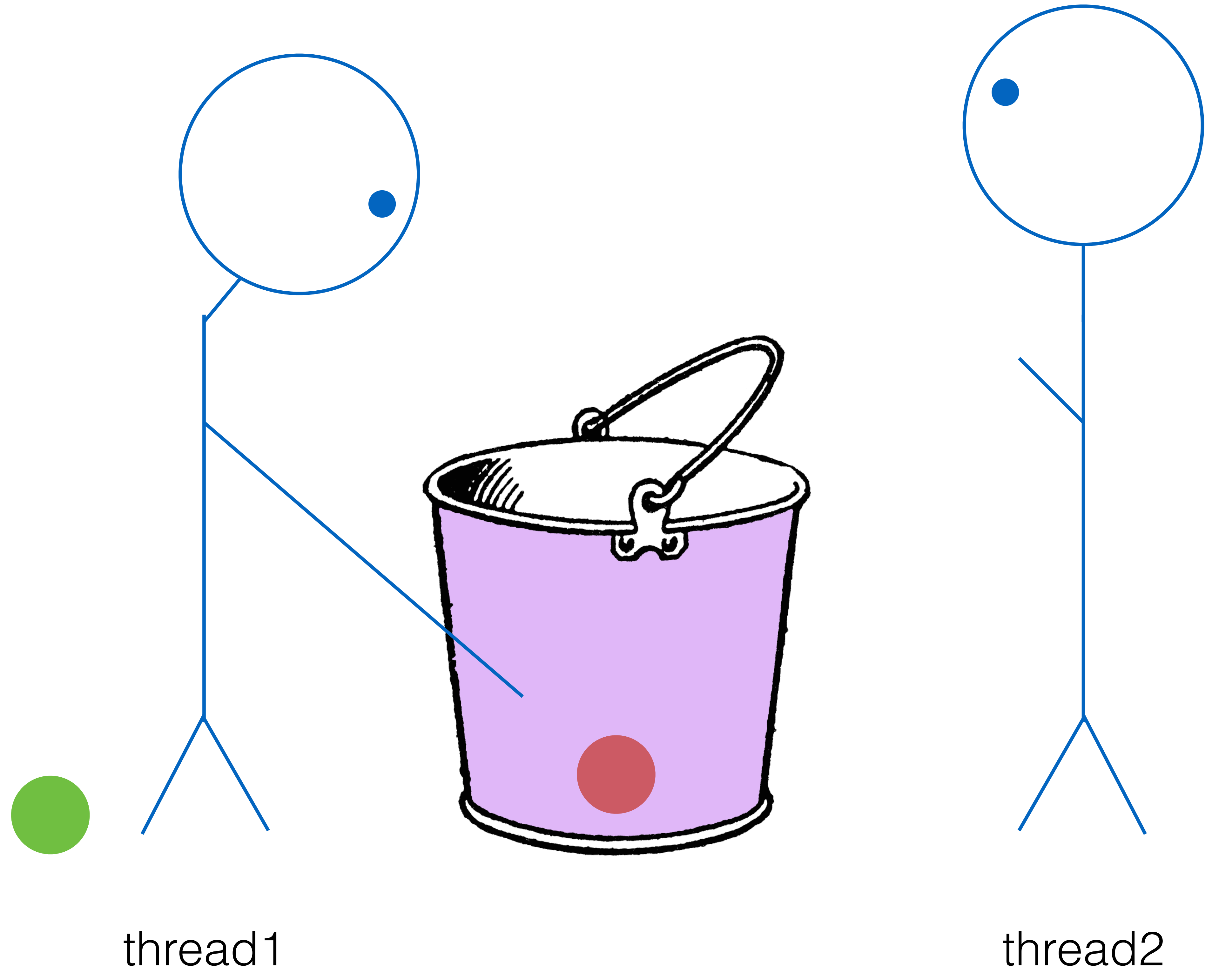

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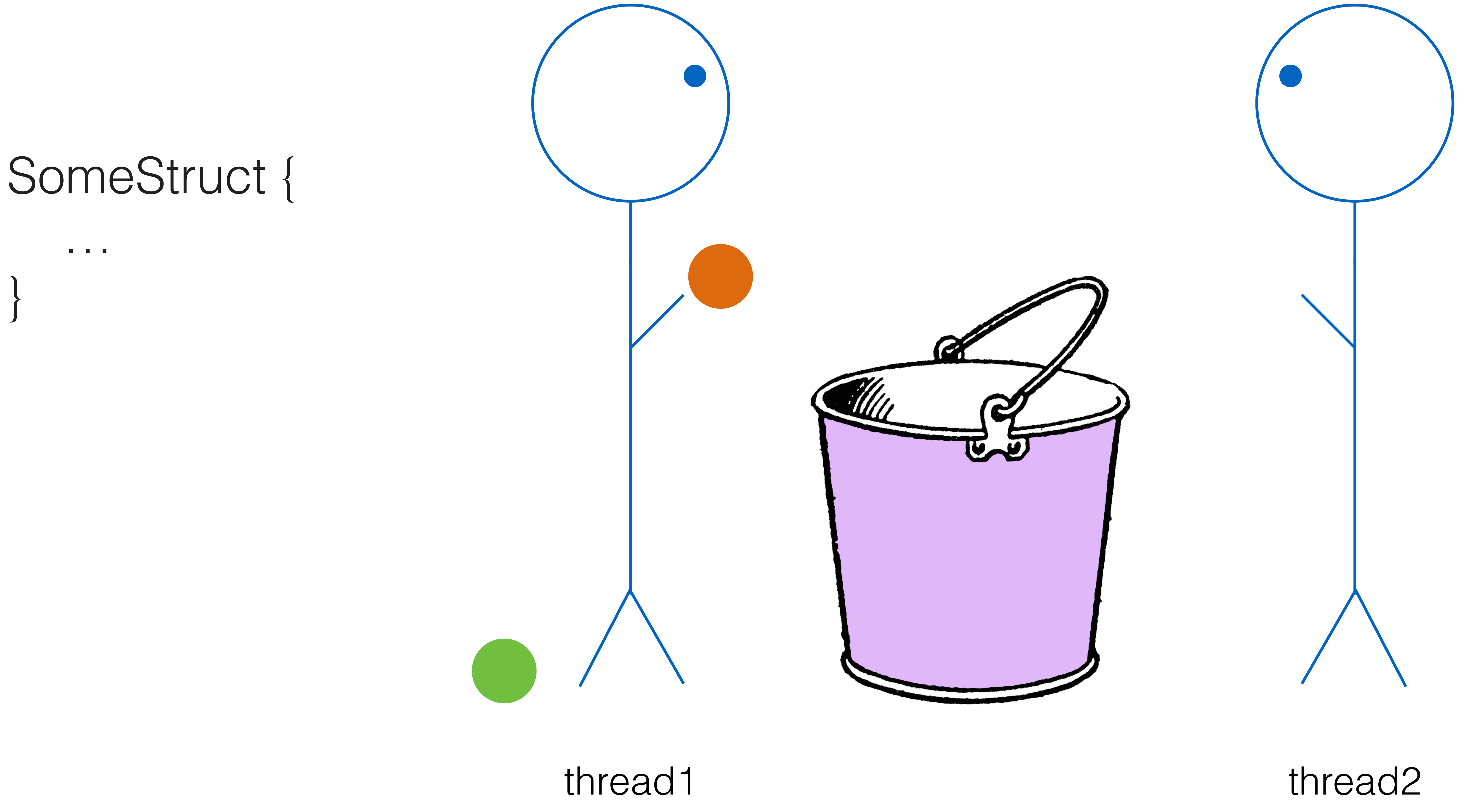

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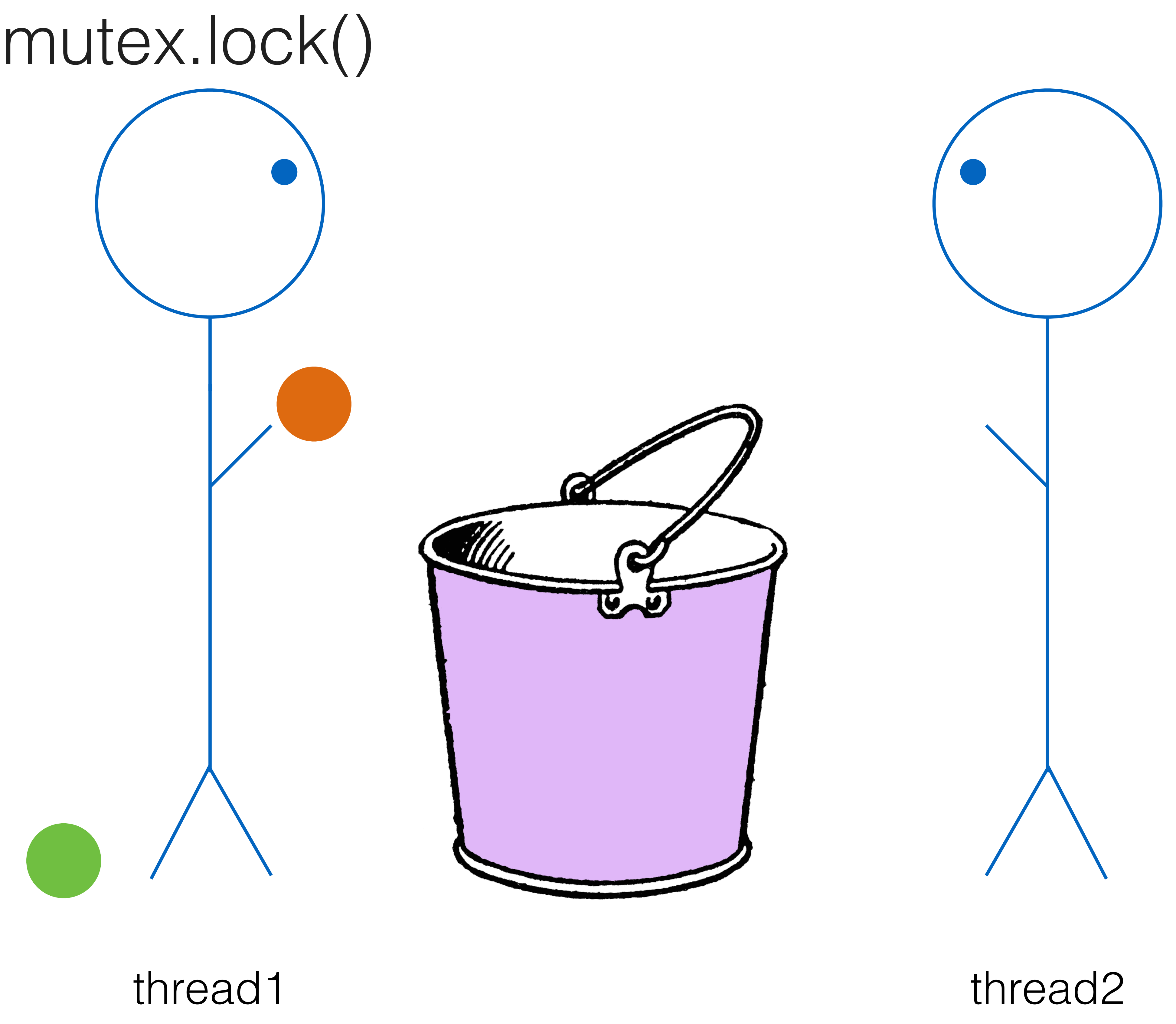

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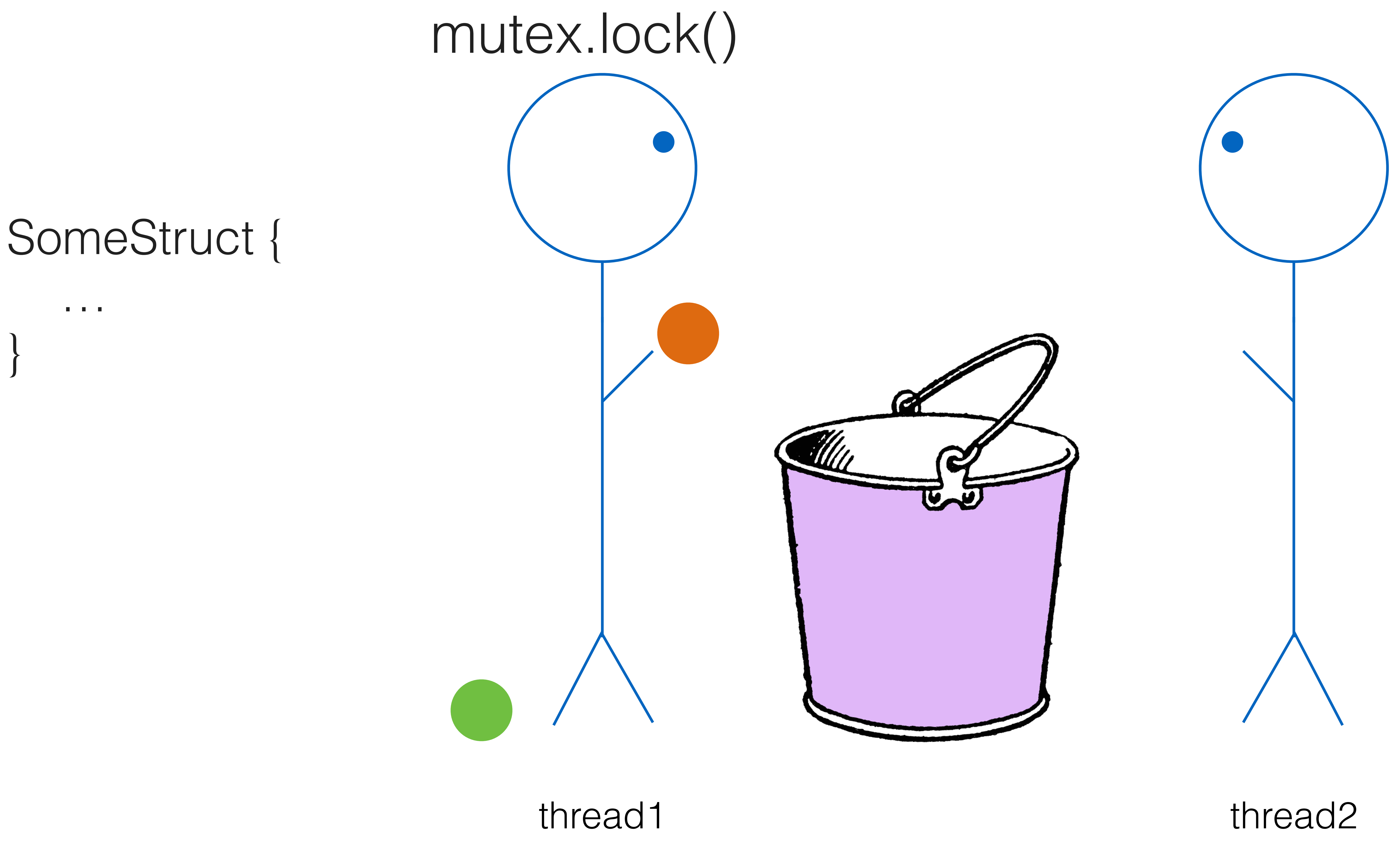

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Producer-consumer: transferring data between threads

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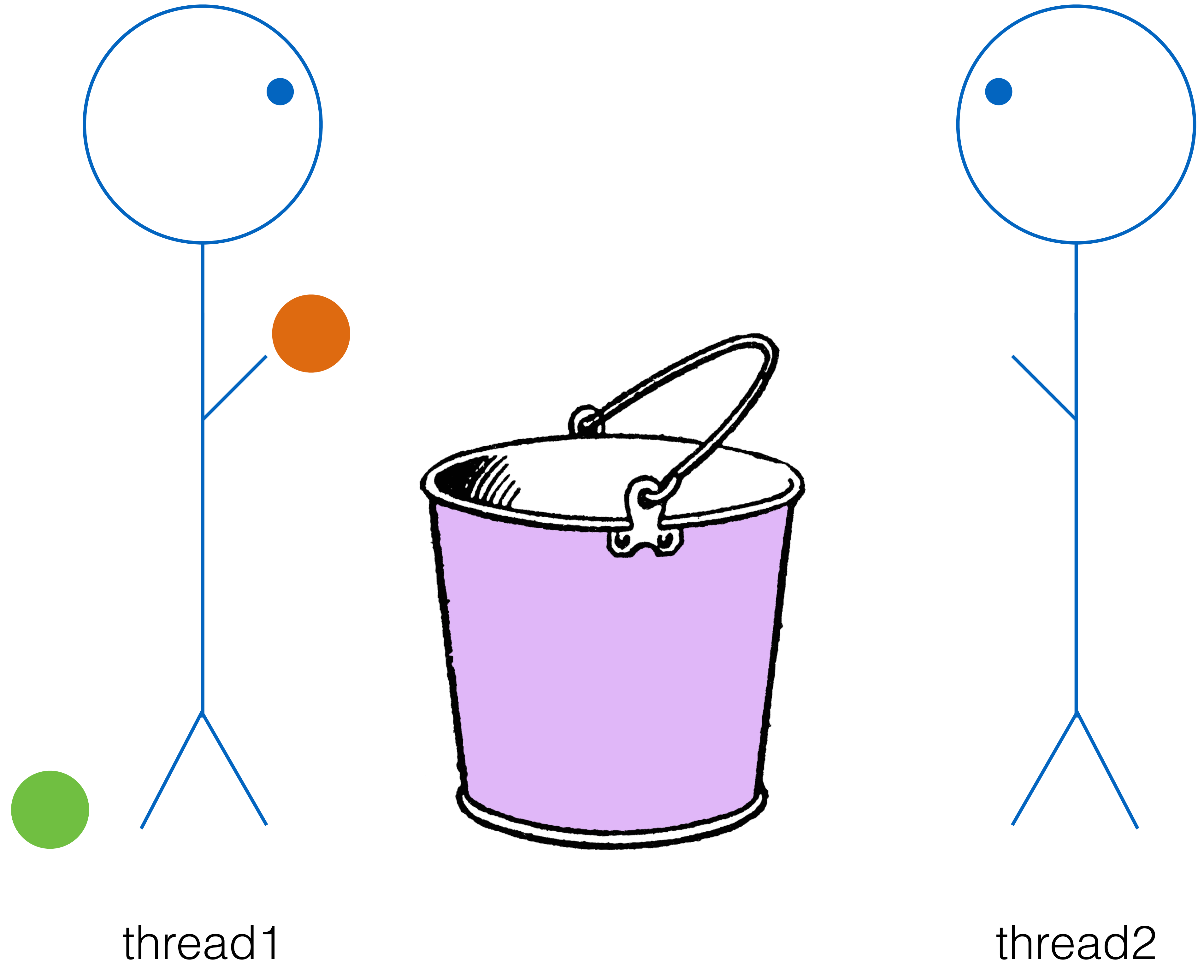
    ...
}

SomeStruct {
    ...
}
```



Mutex: Locked

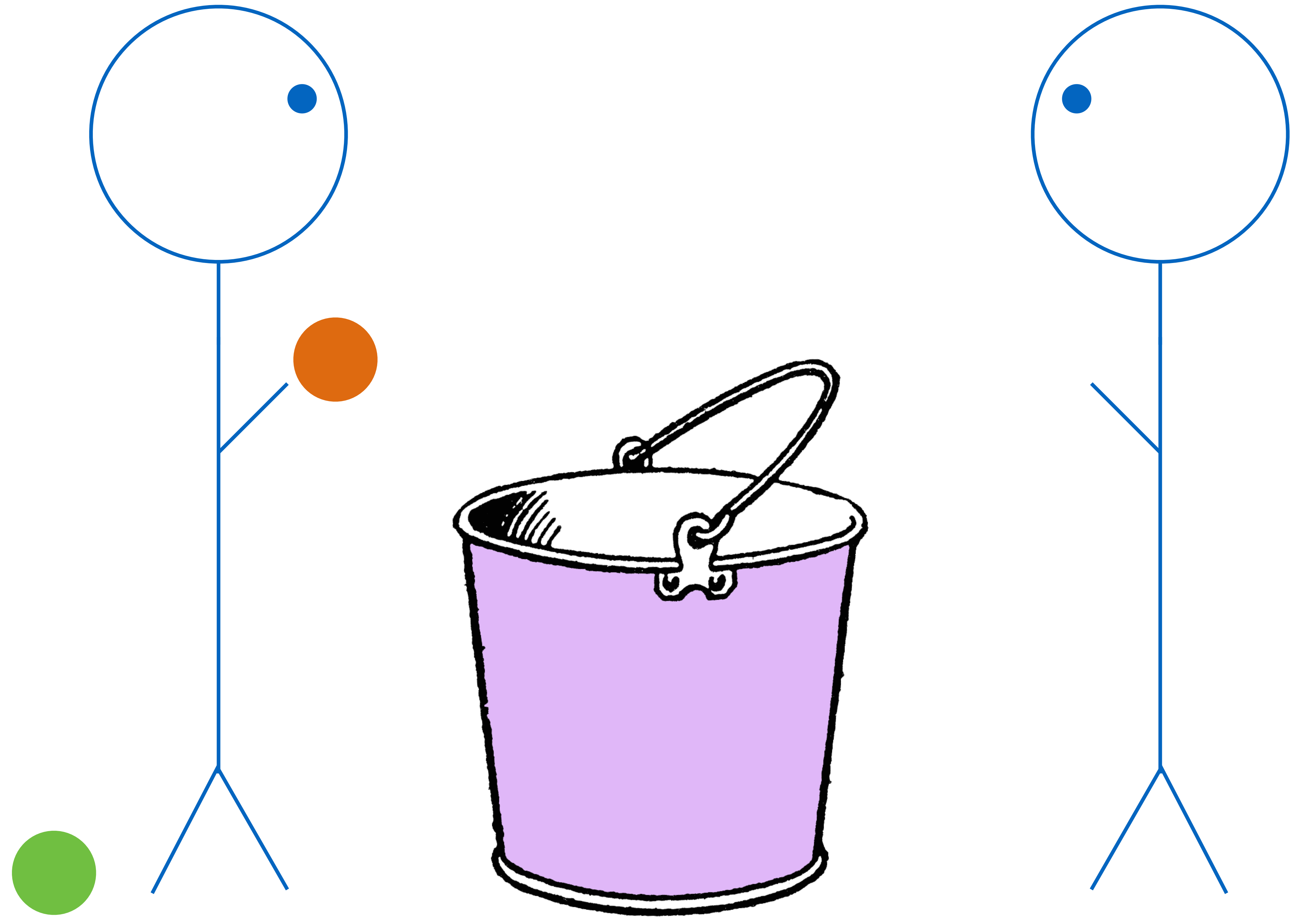
Buffer:

Producer-consumer: transferring data between threads

mutex.unlock()

```
SomeStruct {
    …
}

SomeStruct {
    …
}
```



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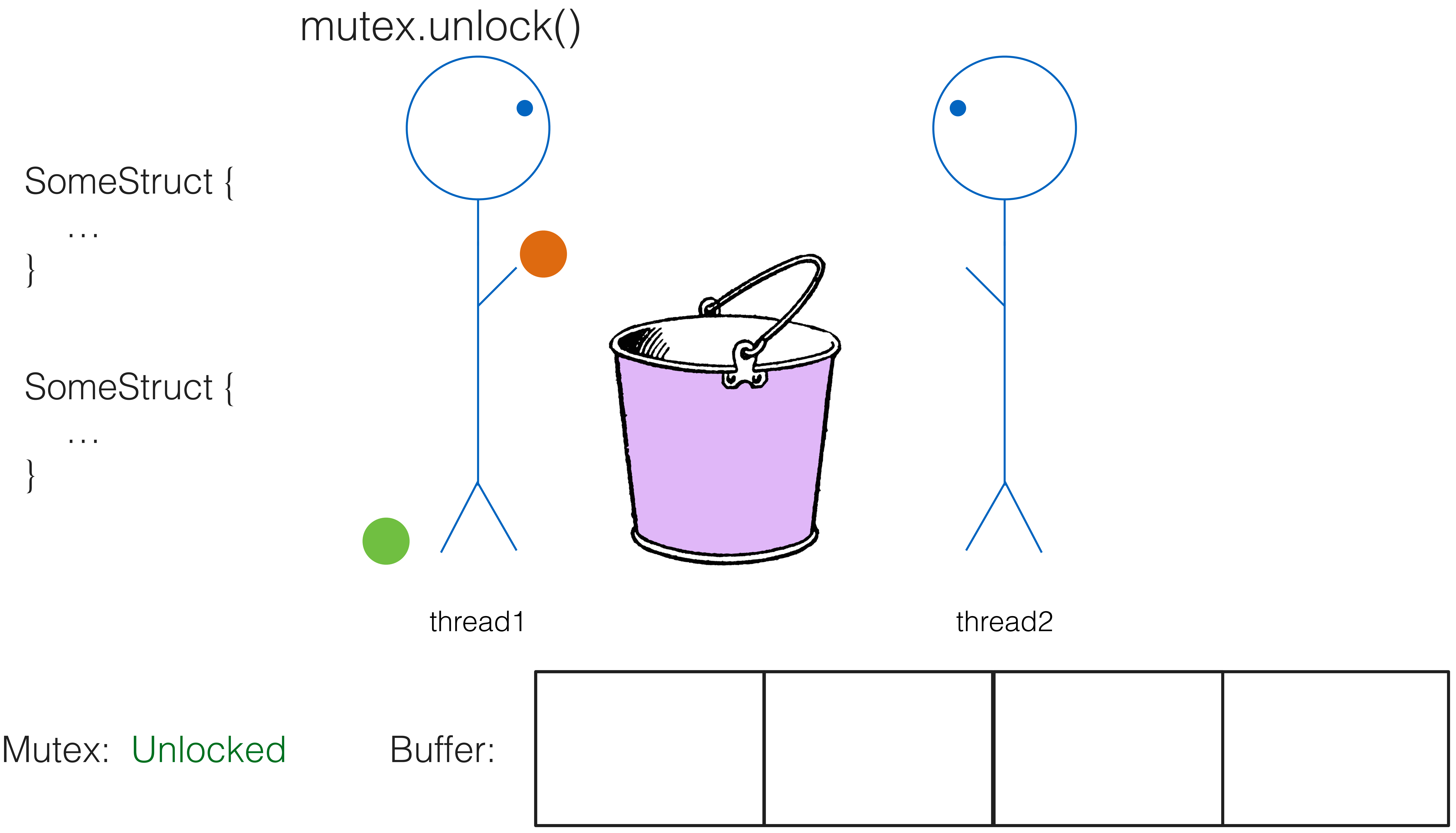
mutex.unlock()
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...
}
SomeStruct {
...
}
thread1
thread2
Mutex: Unlocked
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